Instruction Manual

Simrad EY500

Portable scientific echo sounder

SIMRAD
A KONGSBERG Company

Sections

This book is the Instruction manual for the Base version EY 500. It describes how to install the various units used by the EY 500 system, to maintain them and to operate the system safe and efficiently.

1 System familiarization

This section contains a description of the various system modules.

2 Installation and system test

This section describes how to install the system (hardware and software) and how to test it.

3 Operation

This section contains information about the interactive menu system, the echogram layout on the display and printer, the file system, operation examples and description of each menu.

4 Theory of operation

This section describes some of the theory behind the measurements performed by the EY 500; bottom detection, echogram generation, echo integration and target strength.

5 Telegrams and remote control

This section describes the telegram types used by the system to communicate with other computers or networks.

6 Calibration

This section contains calibration procedures, procedures to determine the beam compensation in a split-beam system and procedures for noise measurements at sea.

7 Maintenance

This section describes how to perform the periodic preventive and corrective maintenance.

8 Drawings

9 Appendix: SHOW - Convert Binary EY 500 telegrams to ASCII

Remarks

References

None

The reader

This operator manual is intended to be used by the system operator. He/she should be experienced in the operation of positioning systems, or should have attended a training course.

Note

This manual includes sections that may be revised individually. In the event of a revision to any part of this manual, this "Cover and Contents" section will be replaced.

Document revisions

Rev	Date	Written by	Checked by	Approved by
A	18.12.92	CL	ESt	HS
B	29.06.93	CL	RLN	HS
C	12.01.95	CL	HS	RB
D	25.08.95	CL	HS	RB
E	15.08.96	CL	HS	RLN
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G	21.01.98	CL	GHM	EST

(The original signatures are recorded in the company's logistic database)

To assist us in making improvements to the product and to this manual, we would welcome comments and constructive criticism. Please send all such - in writing or by Email - to:

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References

(The information on this page is intended for internal use)

Documents

Sect	Title	Loc.	File	P.no/Rev
0	Cover and contents	AA062	857-130078	G
1	System familiarization	AA062	857-160017	B
2	Installation and system test	AA062	857-160018	C
3	Operation	AA062	857-160019	C
4	Theory of operation	AA062	857-160020	A
5	Telegrams and remote control	AA062	857-160021	A
6	Maintenance	AA080	852-160022	B
7	Calibration	AA011	859-043867	E
8	Drawings	AA080	857-160023	B
9	Appendix - SHOW - Convert binary telegrams to ASCII	AA062	859-130224	A

Document history

Rev. A First edition containing only section 2 “Operation” and section 3 “Installation, system test and calibration”. Section 3 only contains the chapter on software installation.

Rev. B Complete manual based on software version 4.01

Rev. C Software version 5.0p. Changes in sections “System familiarization”. “Operation”, “Description of telegrams and remote control” and appendix “EK 500 / EY 500 lobe calibration program”.

Rev. D Software version 5.0. Headers and footers have been changed according to the new documentation standard. Each section has been given a new P-number and registration number.

Rev. E Software version 5.20. Changes in the calibration procedures which have been moved from the “Installation” section to its own section. This section is now a common module for both the EY 500 and the EK 500. The “Maintenance” and “Drawing” sections have also been made into common modules for the EY 500 and the EA 501P.

Rev. F Software version 5.30.

Rev. G A new software installation routine has been introduced in the “Installation and system test” section. Section 2 is thus issued in revision C. Refer to EM 130078G.

SYSTEM FAMILIARIZATION

P3400E / 857-160017 / 4AA062

This section contains a description of the system modules of the EY 500 sounder system. It also contains a simplified block diagram and technical specifications.

Document revisions

Rev	Documentation department		Hardware/Software Design		Project/Product Management	
	Date	Sign	Date	Sign	Date	Sign
A	25.08.95	CL	25.08.95	HS	31.08.95	RB

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Document history

(The information on this page is for Simrad's internal use)

Rev. A Original issue. First edition as module. Was section 1 of P2473E.

Rev. B Change in text on page 10 and more detailed printer specifications on page 13.

1 INTRODUCTION

1.1 GENERAL

The SIMRAD EY 500 scientific echo sounder is designed for biomass estimation where portability and low power consumption is important. This high-performance, portable scientific sounder system is the result of combining state-of-the-art echo sounder technology with the latest achievements in personal computers (PCs).

The EY 500 system basically consists of power source, transducer, the EY 500 transceiver, a personal computer (desktop, laptop, or notebook) and an optional colour printer. The EY 500 transceiver is housed in a cast aluminium case designed for the environment encountered in portable use. Emphasis has been placed on simple installation and ease of operation. A variety of computer choices is allowed by using standard Centronics parallel interface between EY 500 transceiver and PC.

Typical applications for the EY 500 are:

- Fish stock assessment in lakes, rivers and shallow waters
- Fish behaviour studies (the split-beam method allows tracking and counting of individual fish)
- Monitoring biomass from buoys
- Pollution monitoring
- Dam surveillance systems

The collected data is processed on-line for generation of colour echograms and tables giving fish densities in up to 10 depth layers. The echogram is presented on the PC display and on an optional colour printer. A file system allows storing of selected data for further analysis by means of the Simrad EP 500 Echo Post-processing System. Sample data may also be stored on hard disk and replayed off-line for easy regeneration or demonstration of survey echo data. A navigation instrument may be connected to the PC serial port, and position data for logging of the survey track can be combined with the measured echo data. Remote control of the EY 500 and output telegrams through serial port are used for online monitoring of acoustic data.

The EY 500 system includes substantial processing power. Bottom detection, echo integration and target strength algorithms are carried out solely in software. The concept used in the receiver design provides an instantaneous dynamic range of 160 dB. At the same time the absolute amplitude measurement accuracy is very high, and combined with a low self-noise this assures correct measurement of all targets.

1.2 DESCRIPTION OF THE EQUIPMENT

1.2.2 Configuration

The EY 500 sounder system comprises

- *Transducer*
- *Transceiver*
- *PC*
- *Power supply*
- *Colour printer (option)*
- *Navigation instrument*
- *Transducer multiplexing (requires external hardware)*
- *Modem for remote control and telegrams*

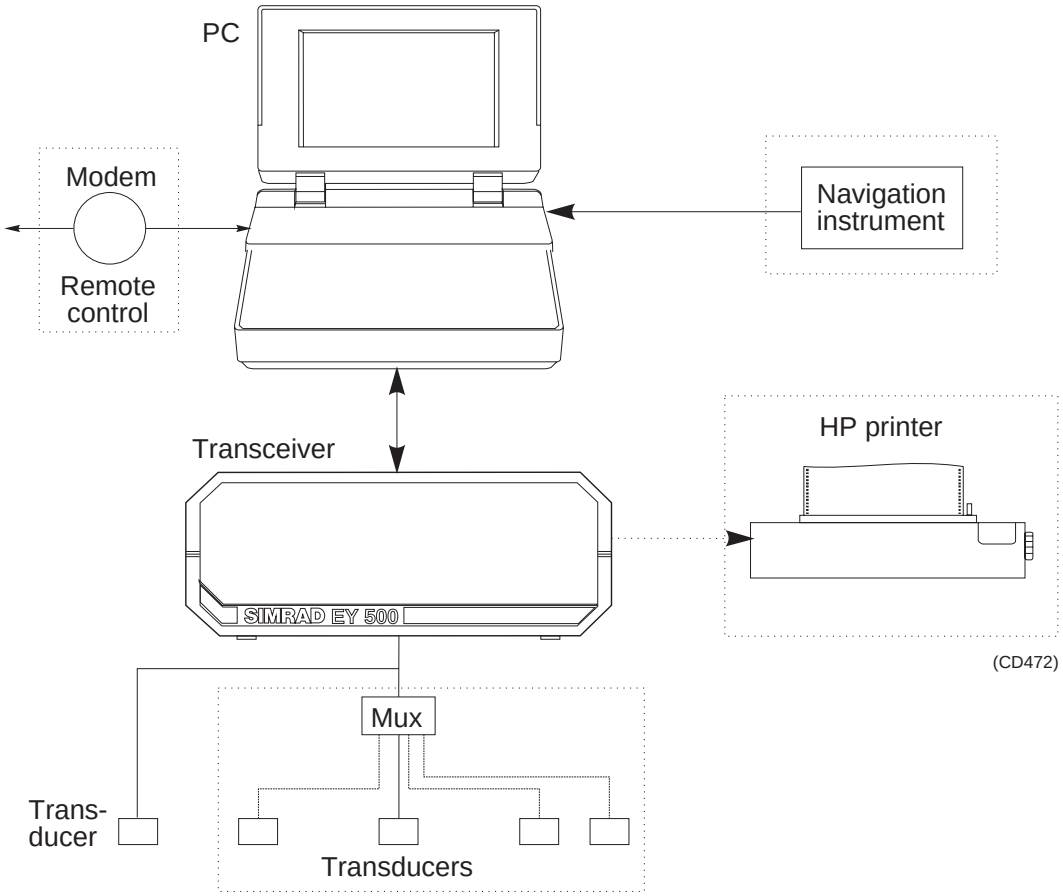

Figure 1 EY 500 system modules.

A range of single-beam transducers is available for different frequencies. Additionally, dedicated split-beam transducers are available for 38, 70 and 120 kHz for measuring target strength.

The minimum requirements for the PC to be used with the EY 500 transceiver are listed under the Technical Specifications.

The EY 500 transceiver requires a supply voltage of 10 to 40 VDC and can be powered from a battery or from an AC power source via an AC/DC converter.

1.2.4 Simplified block diagram

Figure 2 shows a simplified block diagram of the transceiver electronics.

The EY 500 transceiver unit comprises four printed circuit boards:

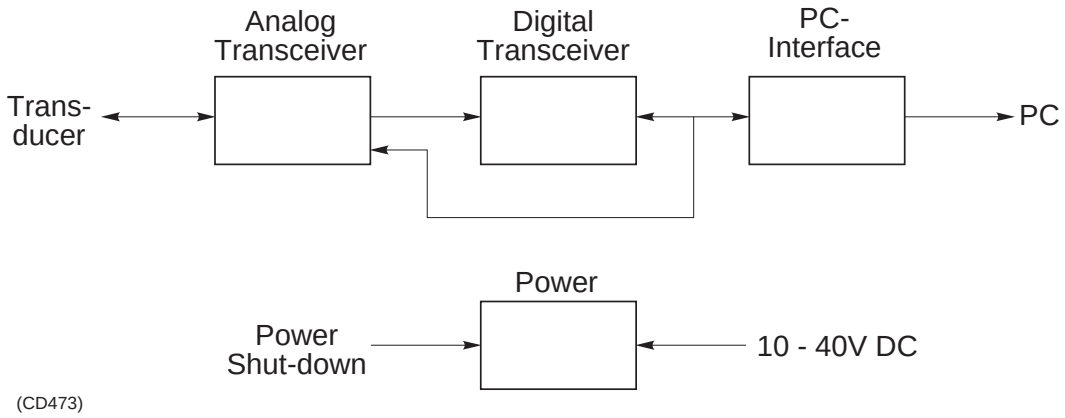

Figure 2 EY 500 transceiver, simplified block diagram.

- *An analog transceiver module containing transmitter and receivers*
- *A digital transceiver module performing A/D-conversion, log. amplitude table lookup and measurement of electrical phase (applies to split-beam operation only).*
- A PC interface module supporting transceiver and Centronics printer interface.
- Power unit

1.2.6 Interconnections

Figure 3 shows the rear panel of the EY 500 transceiver. It has the following connectors:

* COMPUTER (25-pin D-conn. male) for connection to the standard parallel input on the PC. The cable should be less than 1 m and is a 1/1 connection.

* PRINTER (25-pin D-conn female) for connection to the printer input. The printer cable is a standard Centronics cable and should be max. 5 m.

* TRANSDUCER (12-pin Amphenol military standard type connector, female) for single and split beam transducer.

* AUXILIARY (15-pin D-conn female) for output of +5 V, ±20 V. Ground, TX output, 2xfrequency output and power shutdown input control.

* POWER (Cannon connector, male) for 10 - 40 VDC.

* Ground screw.

The PC must have the following ports:

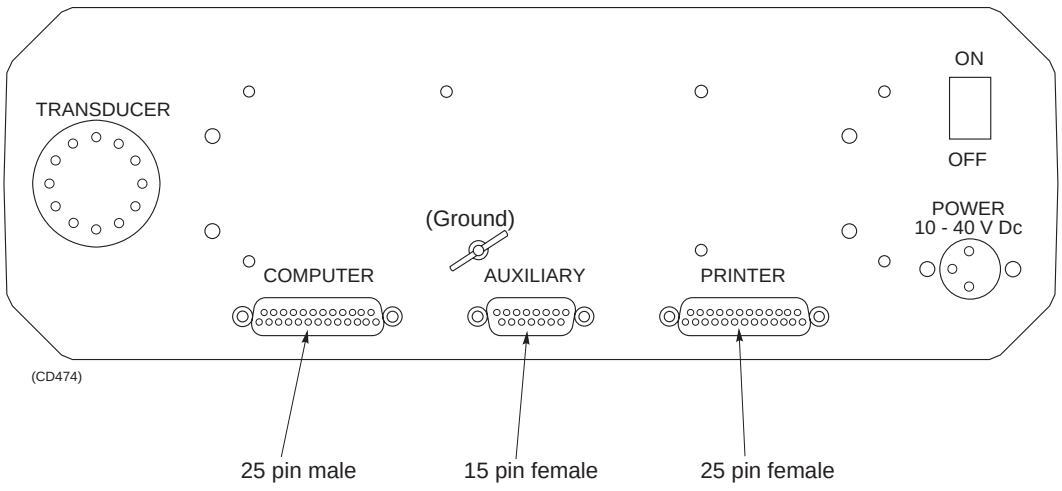

Figure 3 EY 500 rear interconnection panel.

* Centronics port for connection to the EY 500 transceiver

* Serial port for input of navigation data/or remote control and output telegrams.

2 TECHNICAL SPECIFICATIONS

Common specifications for single-beam and split-beam versions:

Frequencies:	38, 70, 120, 200 and 710 kHz
Transmitting power:	50 to 250 W, see table on next page.
Range:	1, 5, 10, 25, 50, 100, 150, 250, 500, 1000, 1500 and 2500 m
Phasing:	0 to 2500 m in 1-m increments.
Display:	Echogram in 12 colours (3 dB per colour) Colour scale related to true volume back-scattering strength or target strength. Scope presentation of echo signal amplitude
Layers:	Up to 10 surface or bottom locked layers.
Integrator:	Virtually unlimited dynamic range. Independent integration within each layer.
Data storage:	Selected EY 500 data and echogram written to hard disk in real time.
Calculation intervals:	Ping, time or simulated speed.
Replay function:	For storing and replaying sample data.

Specifications valid for split-beam version only:

Target strength analyzer:	24 TS classes (1.5 dB per class) in up to 10 layers given in tables Target's position in the beam. Lobe compensated TS values Sample angle data and echo trace data in the super layer
Data storage:	TS distribution in preselected layers.

Options:

Colour printer:	Echogram in 12 colours (3 dB per colour) Tables available on printer for Sa values and TS distribution in preselected layers.
SIMRAD EP 500 Echo Postprocessing System:	Postprocessing system developed by Lindem Data Acquisition. Calculates TS distribution from single beam data (Craigs and Forbes statistical method). Echograms stored in disk files can be presented on display and printer. On-line monitoring of echograms can be done via serial interface. Sa and TS values can be calculated in selectable layers off-line.
Minimum PC specification:	386 AT, 8 MByte RAM, 80 MByte hard disk, Numerical co-processor, Serial port for navigation data input or remote control and output telegrams. Printer port for EY 500 transceiver unit. Note that the parallel interface must be of standard type in order to work properly with the EY 500. Option: storage on streamer (Backpack).
Power system:	DC voltage 10 - 40 VDC AC voltage 110-220 VAC (via AC/DC adapter)

Transceiver:

Supply voltage: 10 to 40 VDC

Power consumption: approx. 15 W
Operating temperature: 0 - 55°

Transceiver parameters:

Frequency (kHz)	Beam type	Power (W)	Pulse duration (ms)			Bandwidth (kHz)		Resolution (cm)
						Narrow	Wide	
37.878	Single	250	0.3	1.0	3.0	0.38	3.8	10
70.422	"	50	0.2	0.6	2.0	0.7	7.0	5
119.047	"	60	0.1	0.3	1.0	1.2	12.0	3
200.000	"	60	0.06	0.2	0.6	2.0	20.0	2
714.286	"	50	0.06	0.2	0.6	7.1	71.4	2
37.878	Split	250	0.3	1.0	3.0	0.38	3.8	10
70.422	"	50	0.2	0.6	2.0	0.7	7.0	5
119.047	"	60	0.1	0.3	1.0	1.2	12.0	3

Maximum detection range for different transducers:

Type	Beamwidth (degrees)	Cable length (m)	Max. detection depth Freshwater (m)			Max detection depth Seawater (m)		
			fish		bottom	fish		bottom
			TS = −30 dB	TS = −50 dB		TS = −30 dB	TS = −50 dB	
38-22	11x22	15	500	170	3000*	360	140	1900
ES 70-11	11x11	15	440	150	1500*	260	120	950
70-24	11x11	15	480	170	1500*	270	130	950
120-25	11x11	25	440	170	900*	230	120	650
ES120-7	7x7	20	500	210	900*	260	140	700
200-7	7x7	15	350	150	600*	190	100	490
200-28	7x7	25	350	150	600*	190	100	490
200-30	30x30	15	110	40	600*	85	35	290
710-30	5x5	15	75	40	160	65	35	130
710-36	2.5x2.5	15	95	60	180	80	50	150

These transducers can be hull-mounted, foil-mounted or provisionally mounted on a rod. The range calculations are valid for water temperature 10°C, Sound absorption according to Francois & Garrison, JASA Dec. 1982, Fish target strength −30 dB and −50 dB, Bottom backscattering strength -10 dB per sq. m, Acoustic noise = SPL-DI+M+B (dB re 1 V) SPL = 142 - 20 log f (dB re 1 μPa per Hz). Electrical noise -189 + B (dB re 1 W), Detection threshold = 10 dB. Seawater salinity 3.5%, 0.3% for freshwater.

* = Sample limited

Transceiver dimensions and weight:

Transceiver: L340 x W350 x H141 mm, 7 kg

Printer specifications:

	PaintJet	DeskJet, type 850C
Paper width	210 mm	210mm
Resolution	720 pixels across paper	720 pixels across paper
Supply voltage	187 - 264 VAC 50/60 Hz 90 - 132 VAC 50/60 Hz 21 - 31 VDC	100-240 VAC 50/60 Hz
Power consumption	20 W max.	48 W max.
Operating temperature	0 - 55°C	5 - 40°C
Dimensions	W442 x H98 x D302 (mm)	W444 x H226 x D396 (mm)
Weight	5 kg	6.5 kg

857-160018 / AA062 / 7-6

EY 500 Installation and system test

This section contains the installation procedures for the EY 500 echo sounder system. It presents a system test procedure, and describes how to install the software.

Document revisions

Rev	Date	Written by	Checked by	Approved by
A	25.08.95	CL	HS	RB
B	15.08.96	CL	HS	RLN
C	21.01.98	CL	GHM	EST
D				

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Document history

(The information on this page is for internal use)

Rev.A First edition as module. Was section 2 of P2473E.

Rev.B Changes in the description of software installation. The chapter about calibration has been removed and is now included in the section “Calibration of the EK 500 / EY 500”, a common module for the EK 500 and EY 500 echo sounders.

Rev.C Software installation chapter updated. Document converted to Interleaf and new standard layout. Refer to EM 160018C.

1 INTRODUCTION

1.1 Installation procedures

The installation of the EY 500 system comprises:

- Deciding the locations for the units.
- Making connections between EY 500 transceiver unit, PC, printer, transducer and power source.
- Installing the software with the EY 500 boot and installation disks which are part of the delivery.
- Testing the system

2 ELECTRICAL INSTALLATION

2.1 Connections

Refer to drawings in section ”Drawings”.

(Ref.1): EY 500 System interconnection diagram 824-111020

(Ref.2): EY 500 Power distribution 824-111022

(Ref.3): EY 500 Power system 824-111079

The following cables and plugs are included in the delivery:

- Power cable for battery (Simrad stock number 380-109648)
- Cable for connection between the COMPUTER plug on the rear panel of the EY 500 transceiver unit and the standard parallel input on the PC (Simrad stock number 380-109897).
- Plug for transducer cable

2.2 Power considerations

The EY 500 system may be powered from either an AC or a DC source. (Refer to drawing EY 500 Power system). In the case of an AC power source (option), all components in the system should use the AC/DC original equipment adaptors to the EY 500 transceiver unit, PC and printer unit. When only battery power is available, the EY 500 should be connected directly to the battery. The PC and the printer should also be powered directly or through DC/DC converters. DC/AC converters may be used provided the measured noise level is acceptable. The best solution for battery life and noise considerations will be to apply power directly to each system unit whenever possible.

2.3 Grounding

Remember to connect the ground screw on the rear panel of the EY 500 Transceiver Unit to the best available ground. Make the cabling as short as possible. Observe the effect of grounding by reading Noise in the Test Menu/ Transceiver.

2.4 Mounting the printer

The printer must be mounted in a near horizontal position for proper long-term operation of the jet ink head.

3 TRANSDUCER INSTALLATION

3.1 Introduction

The EY 500 can use a number of different transducer types, and therefore transducer drawings are not included in this manual. Transducer drawing with installation procedure is included with each transducer delivery. Simrad can supply drawings of blisters of different sizes upon request. Mounting description for transducer foil can also be supplied.

The mounting procedures recommended by Simrad are generally approved by Det norske Veritas. Each individual installation should nevertheless be inspected and approved locally.

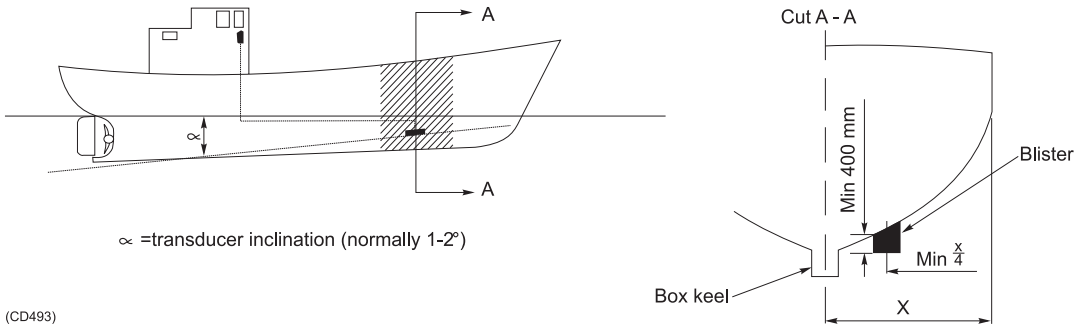


Figure 1 Recommended transducer location.

3.2 Hull mounted transducers

The echo-sounding performance depends to a large extent on the transducer location with respect to hydrodynamic flow noise and propeller noise. The general rules given below should be adhered to as close as possible. Also refer to Figure 1.

The transducer cable must be run in steel pipes all the way up to the echo sounder.

To minimize the propeller interference, the transducer should be located so that the vessel's hull acts as a screen between the propeller and the transducer.

- Mount the transducer at a location between 1/3 and 1/2 of the vessel's length, measured from the bow.
- Incline the transducer so that a line of sight along the transducer radiating surface will pass under the keel below the propeller.
- To avoid cavitation noise, the propeller must be free from damages and roughness. Ample spacing should exist between the propeller blades and the hull.

- On wooden vessels, the propeller noise may be reduced by cutting away wood above and below the propeller. Sharp edges should be well rounded.

The aerated water close to the hull can be disastrous to the echo sounder performance. The transducer should therefore be located in a blister in some distance from the keel or preferably in a box keel or a widened part of same. The localization of a blister is always a compromise. The shape and dimensions of the blister will depend upon the size of the transducer as well as the transverse shape of the vessel's hull.

A general rule is not to have the deepest part of the blister below the keel, and that the height of the blister should always be 400 mm or more down from the vessel's hull. The longitudinal axis of the blister should have a toe-in of approximately 3 to 5 degrees towards the bow, and the bottom must be tilted up 1 to 2 degrees forward, relative to the vessel's water line. The blister centre line will depend on the size of the vessel and is normally 1200-1500 mm off the vessel's centre line. Noise may be reduced by rounding sharp edges. Protruding parts, pipe outlets etc., which may generate hydrodynamic noise, should be avoided in front of, and on the side of the transducer.

3.3 Alternative transducer arrangements

Simrad transducers are well suited for different applications. Some have a short threaded tube around the transducer cable, others have a boat-shaped housing with mounting holes in both ends.

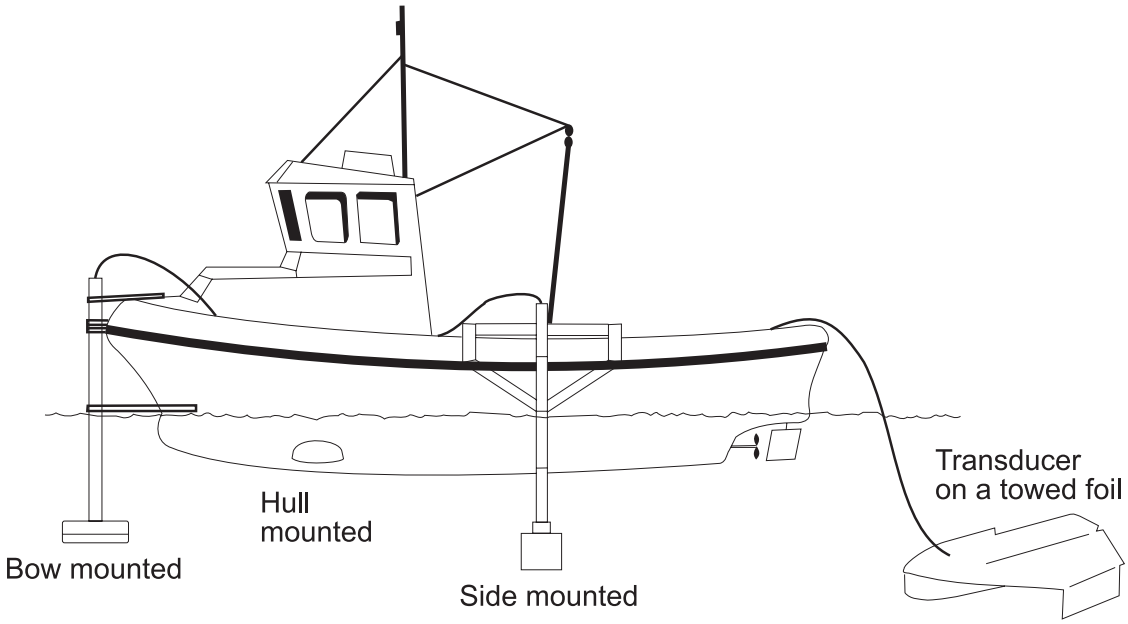
Figure 2 (page 5) shows suggestions for various transducer arrangements. A mounting rack arrangement must be made to fit each individual vessel.

3.4 Transducer foil for towing

Simrad can also supply a transducer foil that can be used with a number of Simrad transducers. The transducer foil is available as a separate unit and will be supplied with necessary weights for the different transducer types. Mounting accessories are also supplied.

The transducer foil must have a rope for towing (supplied by the user). The transducer cable must by no means be used for towing and should be seized to the towing rope with tape (approx. 30 cm between each seizing). The rope should preferably be connected to the towing hook with a quick release connector.

Most of the transducers are delivered with a 15 meter long cable, but some single-beam transducers are supplied with an underwater plug and extension cable. If a longer transducer cable is required, the transducer can be made to order, or a separate extension cable with underwater connectors can be supplied.



(CD492)

Figure 2 Various transducer arrangements.

3.5 Antifouling treatment

After installation, the hull-mounted transducer should be coated with a high-quality antifouling compound like Antifouling Seamate HB 66 from Jotun, Sandefjord, Norway, or equal types.

3.6 Connection to the EY 500

Refer to drawing 824-111021, EY 500 Transducer connections in section "Drawings".

If the EC Declaration of Conformity is to be fulfilled, the transducer cable has to be threaded through a steel pipe from the hull to the EA 501P transceiver unit.

4 SOFTWARE INSTALLATION

4.1 Introduction

Check that the minimum system requirements for the EY 500 PC are met:

- IBM AT compatible PC with numerical coprocessor (80486 or higher)
- 100 % IBM AT compatible parallel printer port
- $\geq$ 8 Mbytes of RAM
- Standard VGA graphics
- 3 1/2″ bootable floppy drive for 1.44-Mbyte diskettes
- DOS version 3.3 or above
- $\geq$ 80 Mb harddisk

Use the **RMX Boot & Installation Disk** for the initial system testing.

Note ! *Do not start on the installation on harddisk part before the RMX boot session has been verified !*

4.2 RMX boot session

Follow this procedure:

1 Turn off the PC and the Transceiver Unit

2 Connect the PC printer port to the Transceiver Unit.

- Use the Computer input

3 Insert the DC power plug into the Transceiver Unit

4 Set the switch on the Transceiver Unit's rear panel to **On**.

5 Check the Transceiver Unit's front panel for the red light power on indication

6 Insert the **RMX Boot & Installation Disk** into the bootable floppy disk drive (A:) and switch on the PC

7 Select **BOOT RMX** in the **MS-DOS Startup Menu**

8 Follow the instructions on the display.

9 When the EY 500 program is running, use the arrow keys for menu selections.

10 Select the **Transceiver** menu and check that the frequency is correct.

11 Enter the **Utility** menu, and set **Default Setting** to **Yes**.

12 Enter the **Operation** menu and set **Ping Mode** to **Normal**.

Pinging starts with an echogram showing the transmitter pulse on the upper part of the display. If everything looks normal, you may now continue with the installation on harddisk procedure described below, otherwise enter the *System error diagnostics* session.

4.3 Installation on harddisk

1 Insert the **RMX Boot & Installation Disk** into the bootable floppy disk drive (A:) and turn on the PC.

2 Select **Install EY 500** in the **MS-DOS Startup** menu.

3 Follow the instructions on screen.

Several subdirectories are created, and the RMX system files are copied from the floppy disk onto the C: harddisk drive.

4 When prompted, insert the EY 500 **Program** disk into the A: drive and type

install

- The EY 500 program directory is created and the EY 500 program files are copied from the floppy disk onto the C: harddisk drive

To verify a sucessful installation:

5 Rename your CONFIG.SYS file to CONFIG.OLD.

6 Rename your AUTOEXEC.BAT to AUTOEXEC.OLD

7 Copy the file AUTOEXEC.RMX to AUTOEXEC.BAT

8 Copy the file CONFIG.RMX to CONFIG.SYS

9 Remove any floppy disk from the floppy disk drive and reboot the PC.

The following text now appears:

```
DOS/WINDOWS
EY 500
```

10 Select EY 500 to start the EY 500 program.

If installation and running the EY 500 program is successful:

11 Reboot the PC.

12 Select DOS/WINDOWS on the start-up menu.

13 Start any text editor in order.

14 Open the CONFIG.SYS file.

- The content of the new CONFIG.SYS file is:

```
[menu]
menuitem=DOS,DOS/WINDOWS
menuitem=RMX,RMX

[DOS]
REM Insert all your regular CONFIG commands here

[RMX]
buffers=40
files=64
lastdrive=V
```

15 Copy the contents of your CONFIG.OLD file into the new CONFIG.SYS file.

- Place the contents after the sentence:

`REM Insert all your regular CONFIG commands here.`

16 Save the edited CONFIG.SYS file.

17 Open the AUTOEXEC.BAT file.

- The contents of the new AUTOEXEC.BAT file is:

```
goto %config%

:DOS
REM Insert all your regular AUTOEXEC commands here
goto end

:RMX
c:\dosrmx\rmxtsr.exe
c:\dosrmx\loadrmx.exe -n c:\dosrmx\dosrmx -s c_dos -f d -w
@cls
@echo off
echo *--*--*--*--*--*--*--*--*--*--*--*--*--*--*--*--*--*--*
echo *                                                     *
echo * Type "<ALT><SYS-REQ>" to switch to iRMX             *
echo *                                                     *
echo *--*--*--*--*--*--*--*--*--*--*--*--*--*--*--*--*--*--*
goto end
:end
```

18 Copy the contents of your AUTOEXEC.OLD into the new AUTOEXEC.BAT file.

- Place the contents after the sentence:

```
REM Insert all your regular AUTOEXEC commands here.
```

4.4 System error diagnostics

If a problem should occur, check the PC configuration information against the example shown below:

Numerical Coprocessor:	Present
Base Memory Size:	640 kilobytes
Extended Memory Size:	7328 kilobytes
Video Mode:	3, Width: 80, Length: 24
Video RAM Address:	B800H:0H
Video RAM Size:	4096 bytes
Video Adapter:	Port Address: 3D4H, Mode Register: 29H
Parallel Port(s):	LPT1=378H
Serial Port(s):	COM1=3F8H, COM2=2F8H
Platform type:	AT

- Check that parallel port and serial port have correct I/O addresses.
- Check that parallel port mode is set to Standard IBM compatible mode (output only).
- Extended memory should be greater than 7 Mb.
- Check data for the Video adapter.
- If necessary, turn any Power Management system OFF.

5 SYSTEM TEST

This procedure should be followed when the system is powered up for the first time.

1 Check the system cabling.

2 Check the supply voltage.

3 Switch on the EY 500, the printer and the PC in this sequence.

4 Do the software installation

5 Select EY 500 on the PC

6 The display should present a menu on the left side of the screen

7 Enter the **Test** menu - **Version** and check that the correct software version is installed.

8 Enter the **Transceiver** menu and check for correct frequency.

Set **Mode** to **Test** and measure the amplitude of the internal test oscillator to be -61 dB ±2 dB re 1W.

When finished, set **Mode** to **Active**.

9 Enter the **Operation** menu and select **Normal** mode.

- The system will commence transmitting after a few seconds. The display should present the transmit pulse at the top of the screen, and then an echogram scrolling over the screen.

10 Enter the **Test** menu - **Transceiver** and observe Noise.

- The noise level should be measured with the transceiver in **Passive** mode.
- Readings above -130 {dB re. 1 watt} are considered as a high noise level. (Remember that a lower number means a higher noise level).

If a printer is connected:

1 Check the cabling between the EY 500 transceiver unit and the printer.

2 Switch on the printer, check that it is "On-line". Make sure that the paper is loaded properly and that the paper may run freely.

3 Enter the **Printer** menu and select **Model Type** (*PaintJet* or *DeskJet)*.

4 Select **Echogram**. With **Echogram** set to **Slave**, the printer output will be equal to the display presentation.

OPERATION

P3402E / 857-160019 / 4AA062

This section contains information about the interactive menu system, the echogram layout on display and printer, the file system, operation examples and descriptions of each menu.

Document revisions

Rev	Documentation department		Hardware/Software Design		Project/Product Management	
	Date	Sign	Date	Sign	Date	Sign
A	25.08.95	CL	25.08.95	HS	31.08.95	RB
B	15.08.96	CL	19.08.96	HS	19.08.96	RLN
C	22.05.97	CL	22.05.97	HS	22.05.97	RLN

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Document history

(The information on this page is for Simrad's internal use)

Rev. A Original issue. First edition as module. Was section 3 of P2473E.
Rev. B Update from software version 5.00 to 5.20.
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1 INTRODUCTION

NOTE !

The EY 500 Instruction Manual is based on software version 5.30.

Changes made in the software may require amendments in this manual.

1.1 THE INTERACTIVE MENU SYSTEM

The EY 500 system is operated via the PC keyboard. Operation is based on an interactive menu system which to a large extent is self-explanatory with all operational options listed on the display.

The keyboard arrows enable you to move a cursor (a reverse field) over the desired choices in the menu. Each press on one of the up or down keys will move the cursor one line up or down in the text. The keyboard arrow pointing to the right is used for moving into different levels in the menu and for entering values. The arrow pointing to the left is used for moving back to a higher level in the menu system.

The start procedure is described in paragraph 1.3. For installation of the EY 500 software, refer to section "Installation, System Test and Calibration".

1.2 ECHOGRAM LAYOUT ON DISPLAY AND PRINTER

1.2.1 Introduction

Figure 1 shows the display layout. The menu field is on the left-hand side of the screen, and the echogram on the right-hand side. In addition to the echoes, the following information may be presented:

- Layer lines
- Super layer
- Bottom range echogram
- Scale lines
- Integration line
- Event marker
- Bottom lines

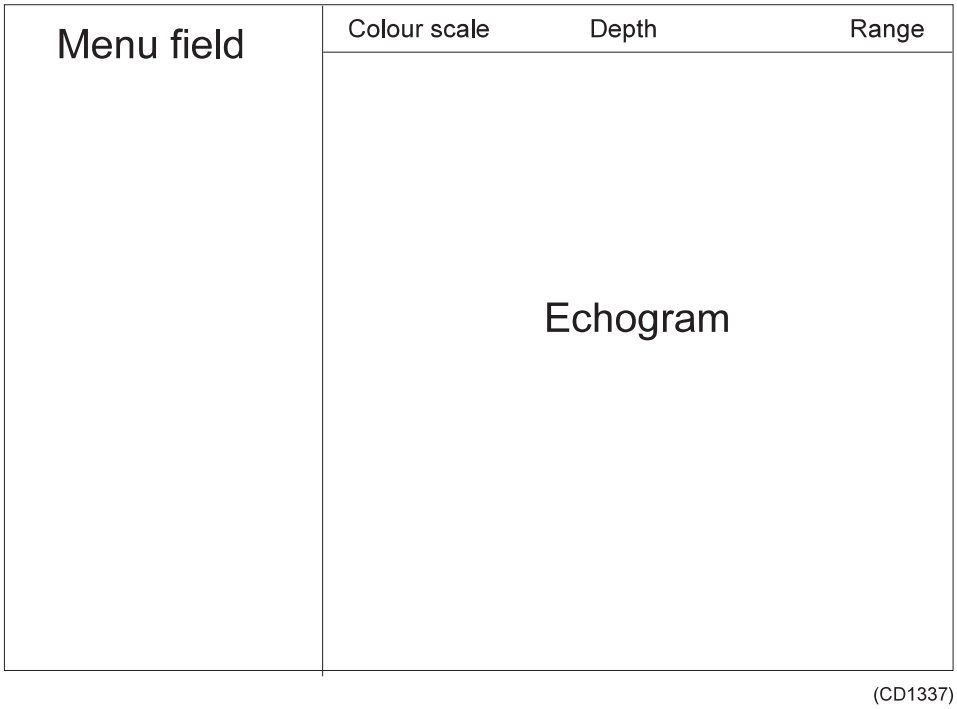

Figure 1. Display layout.

The printer echogram may contain all the information of the display echogram, as well as the additional elements:

- Nautical mile marker
- Annotation
- Date and time
- TS distribution tables
- Integration tables
- Navigation text
- Identification for range, TVG and colour sensitivity

The various elements of the display and printer echograms are described in paragraphs 1.2.3 and 1.2.4.

1.2.2 The colour scale

The echogram has a colour scale which is proportional to the strength of the signals. The echo strength is divided into twelve colour categories, the weakest corresponding to grey and the strongest to brown. The scale is logarithmic with a 3-dB step between each colour, which gives the colour scale a dynamic range of 36 dB from the weakest to the strongest echo signal.

In the Echogram Menu it is possible to set the lower limit of the colour scale relative to target strength or volume backscattering strength (the commands TS colour min. and Sv colour min.).

If, for example, this limit is set to -70 dB, the weakest colour includes the target strength range -70 to -67 dB, while the strongest colour covers the range -37 to -34 dB and stronger (-70 dB + 36 dB = -34 dB). The colour scale is displayed in the upper part of the screen.

1.2.3 Display echogram

The echogram movement across the screen is determined by the setting of the echogram speed parameter (Display Menu) and the current ping interval (Operation Menu). The echogram colour presentation is mainly influenced by TS and Sv colour minimum and the selected TVG type (DISPLAY/Echogram Menu). If the bottom range is enabled, 20% of the main echogram is overwritten by this bottom-referenced echogram. The echogram may include several lines which are enabled by the corresponding parameters in the menu system.

In figure 2 arrows and numbers from (1) to (7) point out the different topics explained below:

(1) Layer lines.

Layer lines appear when the LAYER LINES parameter in the DISPLAY/Echogram Menu is set to ON. All layer lines for the active layers will be in black colour except for the layer selected as the super layer.

The layer lines have higher priority than echo colour and will overwrite it. The layer type and limits for each layer will determine the layout of the layer picture. The surface layers will only have the lines above bottom visible in the echogram. The bottom layer lines will be written relative to estimated bottom depth. If the bottom detector fails to find the bottom depth, all the layer lines described above will be absent. However, if the layer type is set to PELAGIC, the layer lines are always written. In this case the bottom depth is not necessary for successful integration and TS-detection.

(2) Super layer.

One of the layers may be selected as a super layer. The layer selected as super layer will have the layer lines written in red colour instead of black.

The super layer sets the depth limits for controlling several different features in the system:

- TS bar chart on display
- TS detection window on display
- Integration line on display and printer
- Scope presentation.

(3) Bottom range echogram.

BOT. RANGE PRES. in the Display Menu must be enabled. The bottom range echogram is independent of the main echogram since the range settings are separate. It will overwrite 20% of the main echogram and may be placed on different parts of the main echogram. (Refer to DISPLAY/Echogram Menu description).

The bottom range echogram is separated from the main echogram with a solid black boundary line. The bottom range echogram is blanked out if no bottom detection has been done.

If SUB.BOTTOM GAIN is set above 0.0 dB/m, the bottom range presentation will feature an excess gain below the detected bottom.

(4) Integration line.

INTEGRATION LINE in the DISPLAY/Echogram Menu must be enabled. The super layer status must be assigned to one of the layers since the integration line connects to this layer. The deflection line steepness is controlled by the number selected for corresponding S_A value across the echogram paper.

MODE in the Log Menu must be enabled to start integration and thereby causing the integration line to change. The integration line will be reset when log interval or S_A value for one echogram crossing is reached. The deflection value is updated every sub-log interval (normal = 1/200 nm) in SPEED mode. In PING mode it is updated for each ping, while in TIME mode it is updated every 2 seconds.

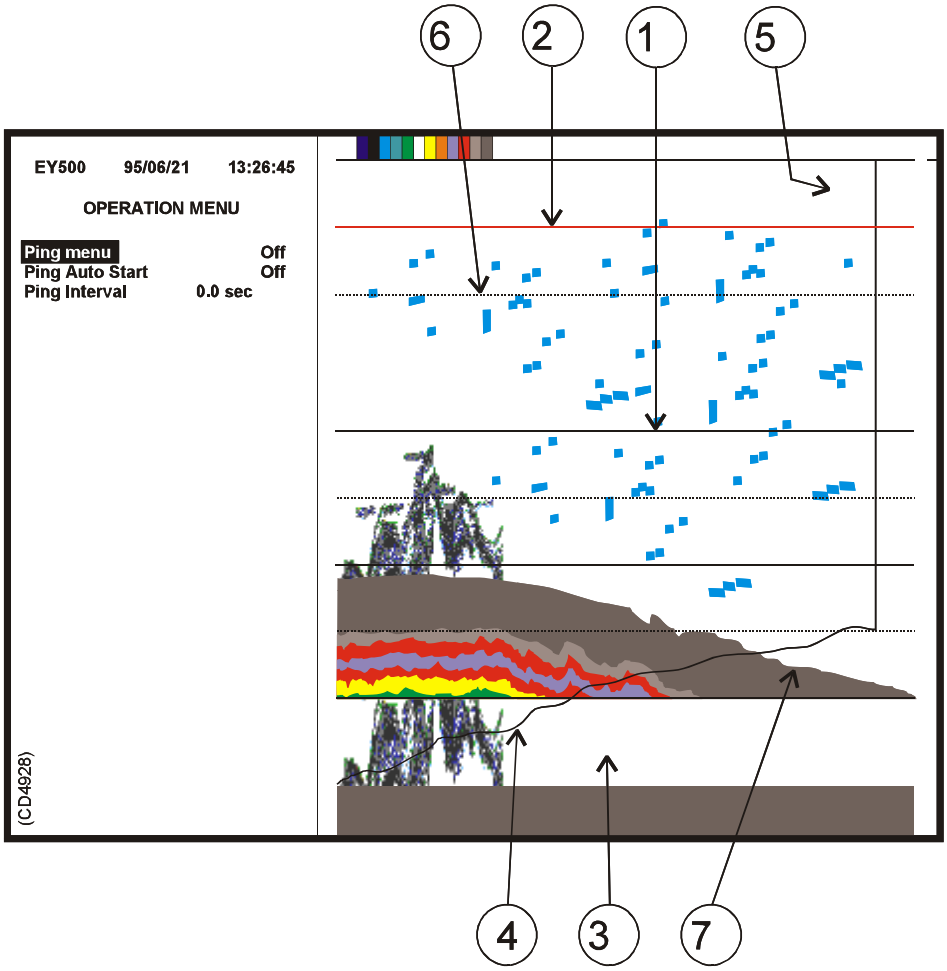

Figure 2. Display echogram.

1. Layer line	2. Super layer line	3. Bottom range echogram	4. Integration line
5. Event marker	6. Scale line	7. Bottom detection line	

Blank page

5) Event marker

EVENT MARKER in the Display Menu must be turned ON. The event input may be caused by EVENT COUNTER in the Annotation Menu. The event will result in a red vertical line.

(6) Scale lines.

If SCALE LINES in the DISPLAY/Echogram Menu is set greater than 0, the selected number of dotted equidistant lines will be written across the echogram.

(7) Bottom detection line.

The bottom detection line may be introduced for easy marking of the bottom (Bot. Det. Line in the Display/Echogram Menu must be set to ON).

The PRESENTATION parameter in the same menu has the following options:

NORMAL
WH. LINE
CONTOUR

These options are described under the DISPLAY/Echogram Menu description.

1.2.4 Colour printer echogram

The printer is able to generate more information than the display. Most elements are controlled by parameters found in the Printer Menu.

The EY 500 may be interfaced to different colour printers. The graphic resolution is 720 dots with 12 different colours ranging from light grey to brown. The black colour is mainly used for text and separation lines.

The echogram paper speed is determined by the setting of the echogram speed parameter (Printer Menu) and the current ping interval (Operation Menu). The echogram colour presentation is mainly influenced by the colour minimum and the selected TVG type (PRINTER/Echogram Menu). If the bottom range is enabled, 20% of the main echogram is overwritten by this bottom-referenced echogram.

The echogram may include several lines and text strings which are enabled by the corresponding parameters in the menu system.

In figure 3, arrows and numbers from (1) to (15) point out the different topics explained below:

1) Layer lines.

   As for display echogram, except that layer lines are switched ON/OFF in the PRINTER/Echogram Menu.

2) Super layer.

   As for display echogram.

(3) Nautical mile marker,

MODE in the Log Menu must be set to SPEED and NAUTICAL MILE MARKER in the Printer Menu must be set to ON. At detection of a new nautical mile, a black vertical line accompanied with text will be written across the echogram paper. The text string shows the log distance in nautical miles plus the NM indicator for easy recognition of the nautical mile data.

(4) Annotation.

Annotations can be entered via the PC keyboard. ANNOTATION in the Printer Menu must be set to ON. The text string entered will be written across the echogram paper after the carriage return character is received.

The maximum text string length is 80 characters.

(5) Date and time stamp.

If the time interval parameter in the Annotation Menu is set to a number greater than 0, the date and time information will be written across the echogram paper with a spacing in time controlled by the number of minutes selected.

The format of this output has a date and a time field with a separation space in the middle.

Example:

```
 9 3 0 1 2 3   0 8 2 5
```

Twenty-five minutes past eight o'clock on the twenty-third of January in the year nineteen ninety-three.

(6) TS distribution table.

The layout for the TS distribution results is shown below:

TS-max = -14.0 dB	TS-step = 1.5 dB	-50	-47	-44	-41	-38	-35	-32	-29	-26	-23	-20	-17	-14
10.0 70	1 Sur. 3.0 15.0	3	33 67 0	0 0	0	0	0	0	0	0	0	0	0	0
93/01/23 kHz	2 Sur. 15.0 30.0	57	7 25 11	54 4	0	0	0	0	0	0	0	0	0	0
08.31.20	3 Sur. 30.0 45.0	84	0 18 8	45 10	6	1	2	5	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5 Bot. 1.0 11.0	28	0 7	21 29	11	14	0	7	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The header in the table above gives the details about the current TS range in use. The first column underneath on the left side adds information about current log distance, date, time and transceiver frequency.

The next column shows the numbers, types and limits for the active layers. Note that the layers without any accepted single fish echoes will be suppressed from this table.

The next column shows the total number of accepted single fish echoes found within each layer. These numbers will give a good indication on the database for the distribution that is given in the next 24 columns.

The numbers in the distribution field is the percentage occurrence in each TS group. The total sum of all groups within each layer should add up to approximately 100 %.

(7) Integration table.

The layout for the integration results is shown below:

10.0 70 93/01/23 kHz 08.02.23	10	9	8	7	6	5 Bot. -80 1.0 11.0 92 10.0	4 Sur. -80 45.0 65.0 99 12.3	3 Sur. -80 30.0 45.0 63 15.0	2 Sur. -80 15.0 30.0 219 15.0	1 Sur -80 3.0 15.0 447 12.0

If the INTEGRATION TABLES parameter is enabled from the Printer Menu and a log interval limit is reached, the integration results will be printed across the paper. The format consists of 11 columns where the 10 rightwards columns have identical layout. The left column carries the log distance, date, time and transceiver frequency information. The other columns show the following settings and results:

- Layer numbers (1 to 10)
- Layer type (Surface, Bottom, Pelagic)
- Sv threshold
- Lower and upper layer limits referred to surface or bottom
- S_A integration numbers (red colour). Note that the S_a(mean) to be used for fish density calculations is S_a (mean) = $S_A/4\pi$
- Average layer thickness (blue colour)

Note that the average layer thickness will become smaller when a layer is intersected by bottom or transmitter pulse (The margin must also be included).

(8) Event marker.

As for display echogram, except that Event Marker is controlled from the Printer Menu. In addition the current event number and navigation data will be written across the echogram paper.

(9) Navigation data.

For navigation data on the printer a connection between the navigation serial port and the navigation instrument must be established. The navigation interval must be greater than 0 in the Printer Menu. If the navigation telegram sent to the EY 500 is decoded successfully, the navigation data will be written across the echogram paper. The output rate is controlled by the navigation interval parameter setting in the Printer Menu.

10) Bottom range echogram.

As for display echogram, except that this echogram is controlled from the PRINTER/Echogram Menu.

11) Integration line.

As for display echogram, except that the integration line is controlled from the PRINTER/Echogram Menu.

12) Scale lines.

As for display echogram, except that the scale lines are controlled from the PRINTER/Echogram Menu.

(13/14) Range and identification fields.

The range and identification fields will always be enabled. The fields will be printed each time the range is changed, and regularly three to four times per page (A4-format) The range information will be written across the paper on top and bottom of the echogram with the corresponding upper and lower depth values given as whole numbers in meters.

The identification field will carry the following two echogram identifiers:

1. TVG-type (**S**v or **T**S)
2. Min colour sensitivity value (no minus sign)

The identification field is placed close to the lower depth range field on the bottom of the echogram, and it represents the major information reference for the echogram.

15) Bottom detection line.

As for display echogram, except that the bottom detection line is controlled from the PRINTER/Echogram Menu.

The SCOPE option is very nice to use during calibration sequence for justification of measured data on reference targets. An example of SCOPE presentation is shown in figure 4.

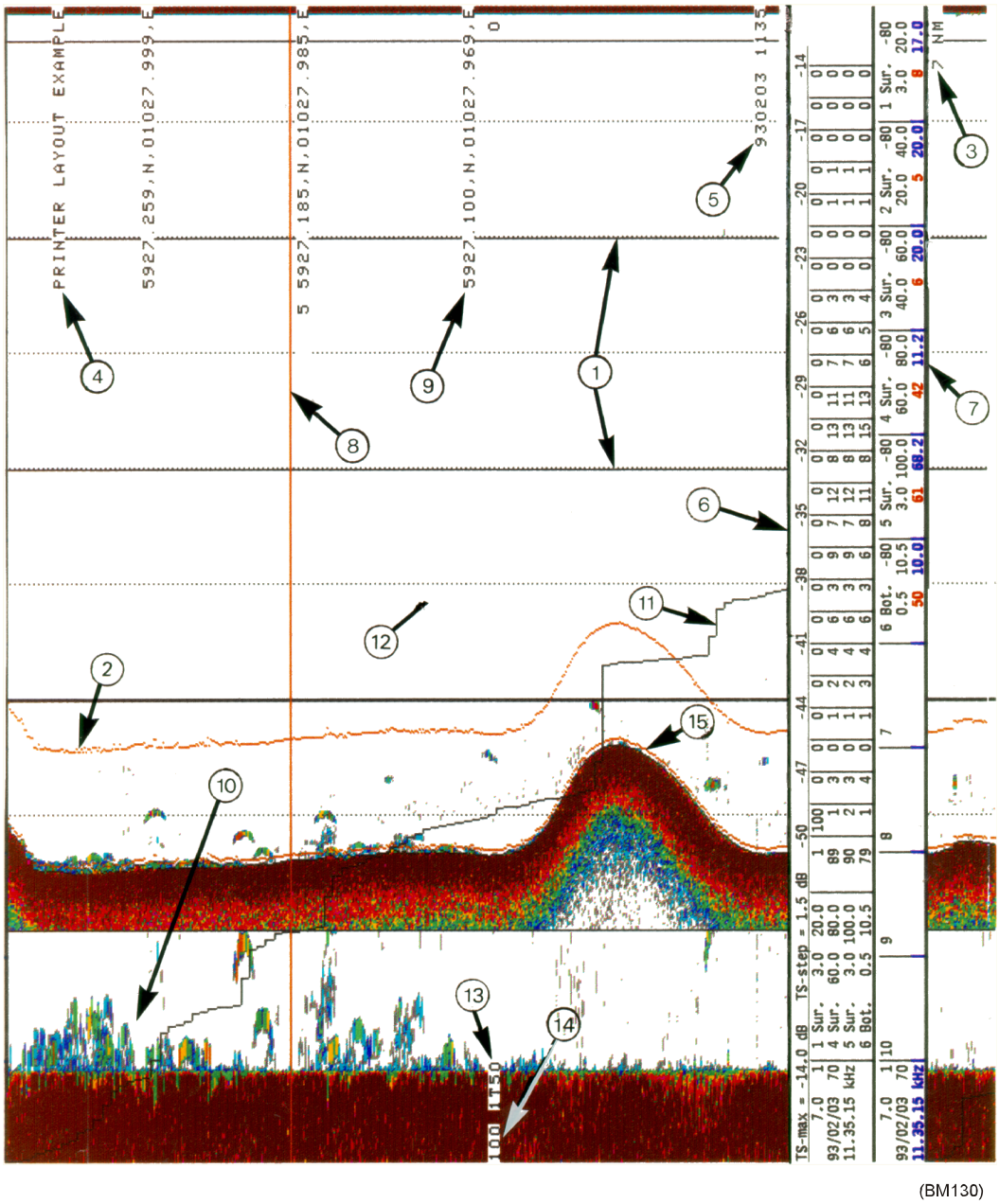

Figure 3. Colour printer echogram.

1 Layer lines	2 Super layer	3 Nautical mile text
4 Annotation	5 Date and time	6 TS distribution
7 Integration table	8 Event marker	9 Navigation text
10 Bottom range	11 Integration line	12 Scale line
13 Identification	14 Range lower	15 Bottom line

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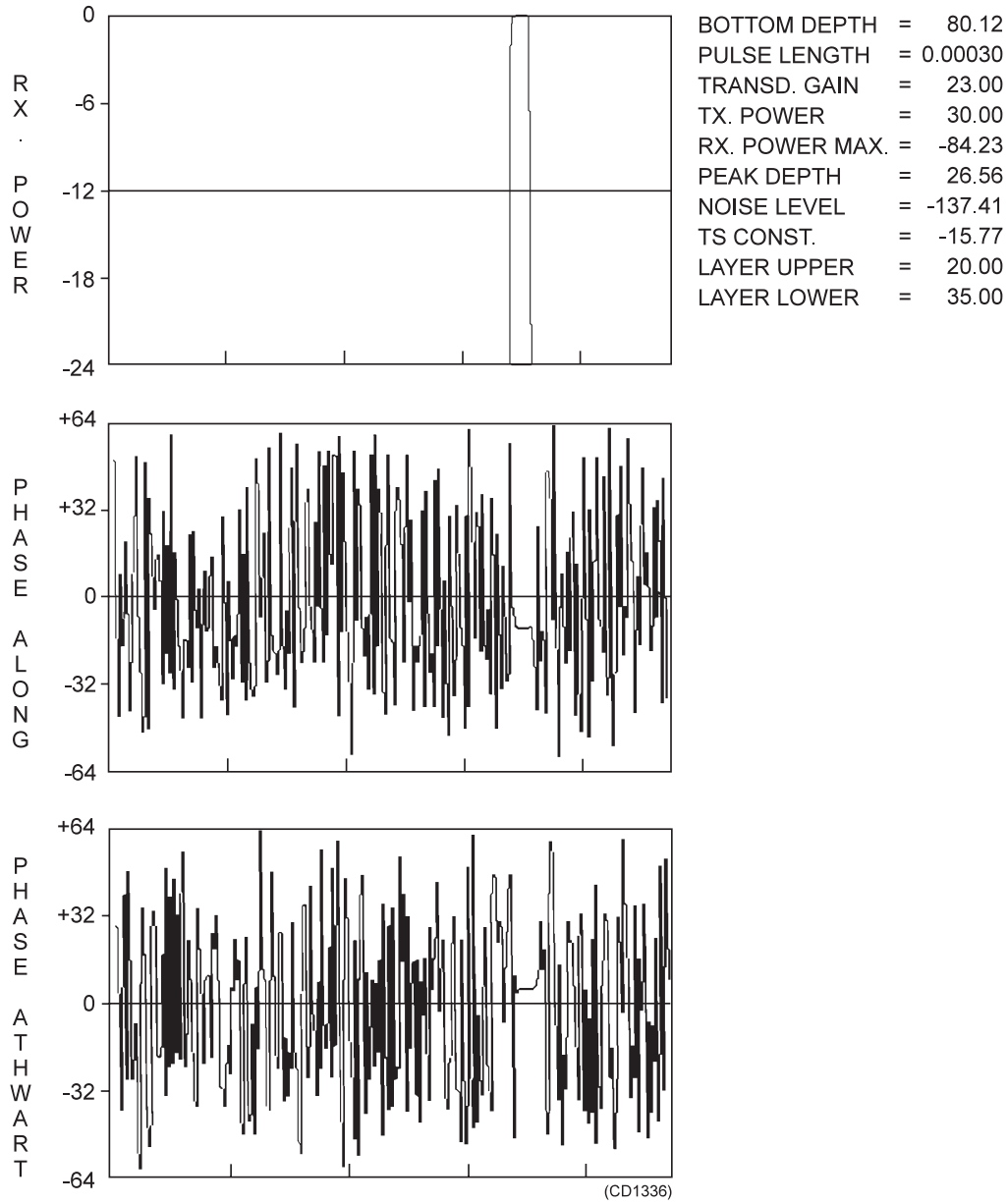


Figure 4. Scope plot showing 300 samples of transceiver data.

1.3 OPERATION EXAMPLES

The following examples describe procedures for a specific setup of the EY 500 with a limited use of its features. The procedure is outlined in a stepwise manner in order to emphasize the structured menu system in the EY 500. The following functions will be examined.

1) Start of pinging
2) 40 log echogram on display (TS)
3) 20 log echogram on printer (S_v)
4) Defining the calculating interval
5) Defining the layer picture
6) Limiting the bottom detection range
7) Monitoring of data
8) Sending data to the hard disk

Make sure that sounder unit, PC and printer (optional) are switched on in this sequence. In this example we assume that MODE in the Transceiver Menu is set to ACTIVE and that ECHOGRAM is enabled. To check this:

Select the Transceiver Menu.
Check that MODE is ACTIVE.
Select the Display Menu.
Check that ECHOGRAM is set to ON.

The use of keyboard arrows is described in paragraph 1.1.

1. Start of pinging

When the sounder unit is turned on, the PING mode is OFF.
Select the Operation Menu and set PING MODE to NORMAL.
After some time delay an echogram will start scrolling from right to left on the display.

If PING AUTO START in the Operation Menu is set to ON and PING MODE is NORMAL, the sounder will start pinging automatically the next time the power is turned on.

2. 40 log echogram on display

Select the DISPLAY/Echogram.
Set TVG to 40 log R.
Set RANGE to the most suitable value referred to the depth.
Set LAYER LINES to ON.
Set TS COLOUR MIN. to the most suitable value according to expected target strength.

3. 20 log echogram on the printer

Select the Printer Menu. Set the printer's MODEL TYPE if the current setting is wrong.
Set ECHOGRAM to ON
Set INTEGRATOR TABLES to ON.
Select the PRINTER/Echogram Menu.
Set TVG to 20 log R.
Set RANGE to the most suitable value referred to the depth.
Set LAYER LINES to ON.
Set SV COLOUR MIN. to the most suitable value referred to expected volume back-scattering strength.

4. Defining the calculating interval

In order to initiate printouts of tables from integration and target strength distribution, and TS distribution bar graph in the TS Detection Menu, the log system must be turned on.

Select the Log Menu.
Set MODE to PING.

5. Defining the layer picture

The layers in the EY 500 are useful for isolating certain depth ranges for data processing. In this exercise only layer No. 1 is used.

Select the Layer-1 Menu.
Set TYPE to SURFACE.
Set RANGE to 50 m.
Set RANGE START to 5 m
Set MARGIN to 1.0 m.

Select the Layer Menu.
Set SUPER LAYER to 1.

The selected layer will then be assigned as super layer. Various special functions are attached to this layer, as described in paragraph 2.8. The layer lines are turned on for both display and printer and will be drawn in red colour at 5 m and 55 m depth.

6. Limiting the bottom detection range

The bottom detector algorithm uses the minimum and maximum depth settings to limit the range of interest for finding the real bottom. Very often the default values will not correspond with the presumed depth pattern in the area of surveying. Therefore, to speed up computations:

Select the Bottom Detection Menu.
Enter the best value according to the maximum expected depth.

7. Monitoring of data

When all of the above parameters are set, it will be possible to monitor the incoming acoustic data by different means. For example in a split-beam system the TS distribution bar diagram (TS-Detection Menu) and the TS window (TS-Detection Submenu) may be useful to study, as well as the integration tables printed together with the echogram on the printer. Scope data may be studied in the Test Menu.

8. Sending data to disk

The disk is an independent device with its own echogram definition. Several telegram types may be enabled for on-line storage. When LOG in the Disk Menu is ON, the data will automatically be given a name including creation time. The file size is limited to the value given in MAX. FILE SIZE in the Disk Menu. The format of the telegrams are described in an appendix. The postprocessing system will read these files and enable the user to scrutinize the data with new layer limits.

The data file will be suited for replaying if the sample power and angle telegrams have been stored.

1.4 THE EY 500 FILE SYSTEM

System files are located in the EY 500 directory.

File name:	**Contents:**
EY500.PAR	Backup parameters of all EY 500 settings.
MoDaHoMi.DGY	Data files containing telegrams. EY 500 files will be automatically created when LOG in the Disk Menu is ON, or when the current file size limit is reached. The file name contains a unique identification with respect to month, day, hours, minutes and year. Example: 12100849.DG4.

12	10	08	49	.	DG	4
Month	Day	Hours	Minutes	.	DG	Year
2-digit identifier (1-12)	2-digit identifier (1-31)	2-digit identifier (1-23)	2-digit identifier (1-59)		EY 500 data-gram	1-digit identifier (1-9)

A list of telegrams is given on page 62, and a detailed description of each telegram is given in section "Description of Telegrams and Remote Control".

Parameter settings may be saved by using the DOS command COPY to save the backup file EY500.PAR with another name, and when these settings are wanted, the same command in reverse order will bring the stored parameters back into use. In this manner, the operator may choose different surveys or situations.

1.5 THE REPLAY FUNCTION

The replay function represents a major enhancement in the EY 500 system. The sample data read from the transceiver may be stored in real time on disk. These sample telegrams include information regarding the following parameters:

- Frequency
- Single/split system
- Transducer type
- Pulse length
- Bandwidth

To store data to disk, first carry out the following procedure:

- Before starting the EY 500, create the directory where you want the data stored.

- Select the Disk Menu.

- Select a directory path.

- Select the Disk/Telegram Menu.

- Set the Sample Range to cover the range of interest.

- Turn on the Sample Power Telegram. If a split-beam system is used, both the Sample Power and the Sample Angle telegrams must be turned on.

- Return to the Disk Menu and turn on Log to start storing of sample data.

Note that the Max. File Size in the Disk Menu may be increased when collecting sample data, in order to limit the number of files.

The maximum number of samples is limited to 10000. The Transducer Depth should be at 0 meters.

The data collected in situ may be replayed again and again with new parameter settings. Thus it is possible to optimize the echo sounder settings by observing the effect of parameter changes. Typical examples are to find the best possible parameters for bottom detection and single fish detections.

To start the replay of a file, carry out the following procedure:

- Select the Disk Menu and select the Directory Path.

- Select the replay file name.

- If continuous replay is desired, turn on Replay Forever.

- Select the Operation Menu and set Ping Mode to Replay.

The replay function may also be used to restore the following survey information:

- Time
- Annotation
- Navigation
- Vessel speed pulses

It is important that the telegrams above are turned on when logging data.

Also notice that when this survey information from Navigation and Vessel Speed is used, the replay function makes possible a complete offline rerun with new parameter settings. This information may be written to a new file to be read by postprocessing systems such as the BI 500 or the EP 500.

Note that the REPLAY message is blinking on the top of the screen to indicate that data is replayed.

2 MENU DESCRIPTIONS

2.1 THE MAIN MENU

The main menu is the top level of the menu system and consists of a list of the menus available in the system.

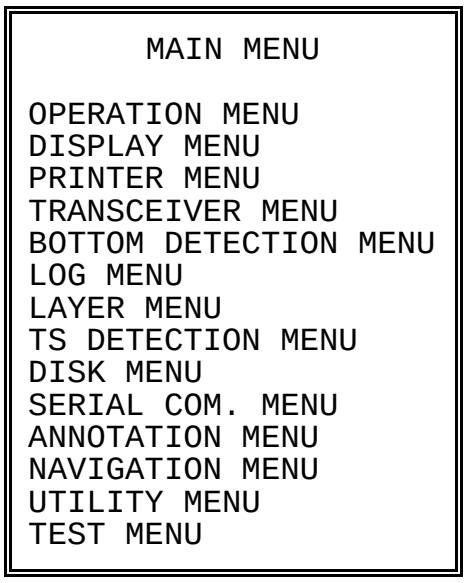
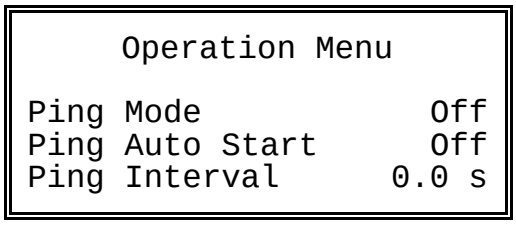


Figure 2.1 Main menu.

2.2 THE OPERATION MENU



The Operation Menu is used to activate the sounder, to choose if the sounder is to start pinging immediately after being turned on and to set the time interval between pings.

Ping Mode Options:

OFF
NORMAL
EXT. TRIG
REPLAY

At power on this parameter is OFF implying that the sounder is not activated. Normal operation occurs when this parameter is NORMAL, provided the transceiver is in the ACTIVE mode. When Ping Mode is set to REPLAY, the file selected in the Disk Menu will be replayed. EXT. TRIG provides synchronization with other equipment. This operation requires special hardware supplied by Simrad. Refer to drawing Ext. sync. cable plan in section 7 in this manual.

Ping Auto Start Options:

OFF
ON

After power on, it will normally be necessary to enter the Operator menu and set PING MODE to NORMAL to start pinging. If PING AUTO START is ON and PING MODE is set to NORMAL, the sounder will start pinging automatically when the power is turned on.

Ping Interval

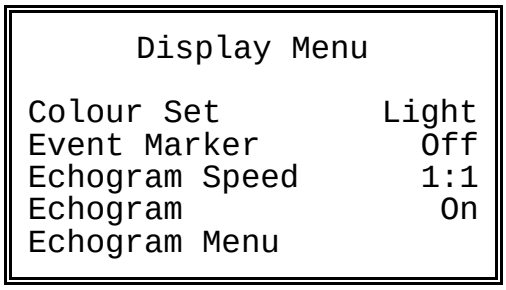
Options:

0.0 to 20.0 in steps of 0.1 second

A fixed ping interval can be set. If the echo sounder is unable to ping as fast as the selected ping interval, a warning will be given, and the ping will be delayed one or more ping intervals. Normal operation is 0.0, i.e. the sounder will ping as fast as possible (only delayed by sound propagation and internal data processing).

If unwanted multiple bottom echoes appear on the echogram, these may be eliminated by changing the ping interval.

2.3 THE DISPLAY MENU



The Display Menu is used to choose between different display modes, to introduce an event marker on the display, to choose the desired speed of the echogram movement across the screen and for switching the echogram presentation on and off. The Display Menu also contains the entry line for the Echogram submenu.

Colour Set Options:

LIGHT
DARK
MONO

Various display modes can be chosen; light or dark background colour, or monochrome for grey scale LCD PCs.

Event Marker Options:

OFF
ON

When ON, a vertical line is drawn across the echogram on the display each time an "event" occurs. Refer to the Annotation Menu description for information about how to generate events.

Echogram speed Options:

1:1 *1:5*
1:2 *1:10*
1:3

With setting 1:1 every ping is displayed. With setting 1:2 every second ping is displayed, with setting 1:3 every third ping is displayed, etc. Note that this is to slow down the display echogram speed only, and has no influence on the other output devices.

Echogram Options:

OFF
ON

To switch the echogram on the screen ON/OFF.

2.3.1 The Display/Echogram Menu

DISPLAY/Echogram Menu	
Transd. Number	1
Range	100 m
Range Start	0 m
Auto Range	Off
Bottom Range	10 m
Bot. Range Start	5 m
Bot. Range Pres.	Off
Sub. Bottom Gain	0.0 dB/m
Presentation	Normal
TVG	20 log R
Scale Lines	10
Bot. Det. Line	On
Layer Lines	Off
Integration Line	Off
TS Colour Min.	-50 dB
Sv Colour Min	-70 dB

The DISPLAY/Echogram Menu is used to choose the desired echogram presentation on the screen. A special bottom echogram may be selected. This echogram is referred to the bottom and its range may cover areas both above and below the bottom. The bottom echogram may be positioned at different places in the main echogram area. Also refer to the description of the display echogram in paragraph 1.2.3.

Transd. Number Options:

1 to 32

To be used only when external transducer multiplexer is included in the system. The command selects which transducer echogram is to be displayed. The command is only effective when TRANSD. SEQUENCE in the Transceiver Menu is ON.

Range Options:

1 m *500 m*
5 m *750 m*
10 m *1000 m*
15 m *1500 m*
25 m *2500 m*
50 m
100 m
150 m
250 m

Depth range across echogram.

Range Start Options:

0 to 2500 meters in steps of 1 m

Upper start depth of echogram.
This parameter is only valid when Auto Range is OFF.

Auto Range Options:

OFF
ON

Automatic adjustment of Range Start aimed at maintaining the bottom echo inside the echogram. When Auto Range is ON, the Range Start value will be ignored.

Bottom Range Options:

0 to 100 m in steps of 1 m.

Range of bottom echogram.

Bot. Range Start Options:

-100 m to +100 m in steps of 1 m.

This command sets the upper start depth of bottom echogram relative to detected bottom depth; positive values above the bottom and negative values below the bottom.

Bot. Range Pres. Options:

OFF
UPPER
BOTTOM
LOWER

While a normal echogram is referred to the surface, the bottom echogram is always referred to the bottom. The Bottom Range Presentation command allows you to position this echogram at different places in the echogram area. Bottom Range Presentation can be OFF, positioned along the UPPER or LOWER boundary of the echogram area, or positioned immediately below the detected BOTTOM inside the echogram.

Sub. Bottom Gain Options:

0.0 to 5.0 dB/m in 0.1 dB/m steps.

This command may improve visual presentation of sub-bottom echoes. When set to 0.5 dB/m an excess gain of 0.5 dB per meter below the detected bottom is added in order to compensate for absorption in the bottom.

Presentation Options:

NORMAL
WH. LINE
CONTOUR

In NORMAL mode the echo signal is continuously recorded as received by the transducer.

WHITE LINE presentation introduces a small gap in the echogram below the detected bottom in order to improve observation of targets close to the bottom.

CONTOUR presentation causes the echogram below the detected bottom to be blanked out.

TVG

Options:

20 log R
40 log R

This parameter controls which transmission loss compensation algorithm is to be used (TVG = Time Variable Gain). 20 log R is selected for echogram presentation of volume back-scattering strength, and 40 log R for presentation of target strength.

Scale Lines

Options:

0 to 250 lines in steps of 1

Allows you to enter a number of equidistant scale lines across the echogram. Scale lines disabled by setting value to 0.

Bot. Det. Line

Options:

OFF
ON

A black line is introduced in the echogram at the current depth, when set to ON.

Layer Lines

Options:

OFF
ON

This command allows you to include layer lines in the echogram. The selected super layer lines have red colour, and all other layer lines are black.

Integration Line Options:

OFF
10
100
1000
10000
100000
1000000

The echo integration buildup within the super layer is plotted as a deflection line. The numeric setting determines the vertical range across the echogram in units of m^2/nm^2. Refer to paragraph ECHO INTEGRATION in section "Theory of Operation".

TS Colour Min. Options:

-100 to 0 dB in steps of 1 dB

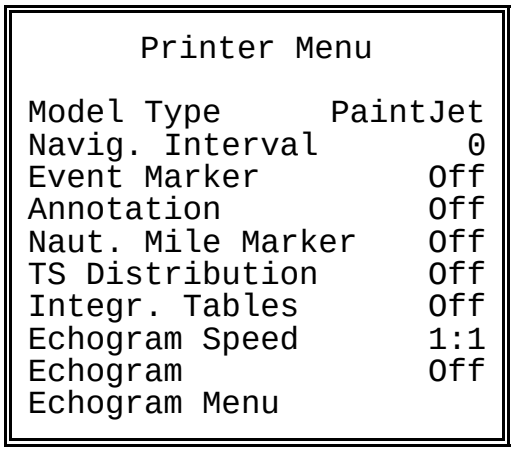
Lower limit of colour scale relative to target strength. If for example this parameter is set to -50 dB, the lowest TS visible on the display will be -50 dB (grey colour).

Sv Colour Min. Options:

-100 to 0 dB in steps of 1 dB

Lower limit of colour scale relative to volume backscattering strength. If for example this parameter is set to -70 dB, the lowest S_v visible on the display will be -70 dB (grey colour).

2.4 THE PRINTER MENU



The Printer Menu is used to choose the desired presentation of echogram and data on the printer printout. Also refer to the description of the printer echogram in paragraph 1.2.4.

Model Type Options:

PaintJet
DeskJet

To select between printer types. The echogram layout for the two printers are identical except that the DeskJet does not have continuous paper feeding. To indicate the sequence of the echogram, the DeskJet puts the page number and the time information on the top of each page.

Navig. Interval Options:

0 to 1000 in steps of 1

This command sets the number of incoming navigation telegrams to the sounder per printout on the printer. If for example the telegrams are coming in every second, you set NAVIGATION INTERVAL to 60 to get a printout every minute. No navigation data will appear on the printer when the NAVIGATION INTERVAL is set to 0.

Event Marker Options:

OFF
ON

When ON, a vertical line is drawn across the echogram each time an "event" occurs. The event number is printed on top of the paper. Refer to the Annotation Menu description for information about how to generate events.

Annotation Options:

OFF
ON

When ON, annotation messages received via the keyboard will be printed.

Naut. Mile Marker Options:

OFF
ON

When ON, every nautical mile will be indicated on the echogram paper if the LOG MODE is set to SPEED. A vertical line is drawn across the paper, and the distance is shown along this line.

TS Distribution Options:

OFF
ON

To select printout of TS distribution table.

Integr. Tables Options:

OFF
ON

To select printout of echo integration table.

Echogram Speed Options:

1:1
1:2
1:3
1:5
1:10

With setting 1:1 every ping is displayed. With setting 1:2 every second ping is displayed, with setting 1:3 every third ping is displayed, etc. This in order to get a more compact history on the echogram or to increase the ping rate.

Echogram

Options:

OFF
ON
SLAVE

To select printout of echogram.

When SLAVE is selected, the printer echogram will be a slave of the display in such a way that the display echogram settings are used directly for the printer.

2.4.1 The Printer/Echogram Menu

PRINTER/Echogram Menu	
Transd. Number	1
Range	100 m
Range Start	0 m
Auto Range	Off
Bottom Range	10 m
Bot. Range Start	5 m
Bot. Range Pres.	Off
Sub. Bottom Gain	0.0 dB/m
Presentation	Normal
TVG	20 log R
Scale Lines	10
Bot. Det. Line	On
Layer Lines	Off
Integration Line	Off
TS Colour Min.	-50 dB
Sv Colour Min	-70 dB

This menu is identical to the DISPLAY/Echogram Menu except for SCOPE in the PRESENTATION submenu. For the other menu descriptions, refer back to paragraph 2.4.1 The DISPLAY/Echogram Menu. Also refer to the description of the printer echogram in paragraph 1.2.4

Presentation Options:

NORMAL, WH. LINE and CONTOUR as in the DISPLAY/Echogram Menu.

SCOPE presentation is intended for special purpose studies of the echo return and causes an oscilloscope-like plot of a single ping to be printed. Echo amplitude and directional angles are plotted; echo amplitude in units of dBW (referred to the transducer terminals) and directional angles in units of phase steps (64 phase steps = 180 electrical degrees). The plot starts at the upper depth boundary of the super layer, and a total of 300 samples (basic hardware sampling rate of transceiver) is plotted. Note that no echogram is plotted during the printout period. Refer to figure 4.

2.5 THE TRANSCEIVER MENU

Transceiver Menu 38 kHz	
Mode	Active
Transducer Type	ES38B
Transd. Sequence	Off
Transducer Depth	0.00 m
Absorption Coef.	10 dBkm
Pulse Length	Medium
Bandwidth	Auto
Max. Power	125 W
2-Way Beam Angle	-20.6 dB
Sv Transd. Gain	26.50 dB
TS Transd. Gain	26.50 dB
Angle Sens.Along	21.9
Angle Sens.Athw.	21.9
3 dB Beamw.Along	7.1 dg
3 dB Beamw.Athw.	7.1 dg
Alongship Offset	0.0 dg
Athw.ship Offset	0.0 dg

The Transceiver Menu is used to set important receiver and transmitter parameters. In this menu all the parameters will influence on the final result and must therefore not be tampered with.

The transceiver in the EY 500 has a unique signature corresponding to its frequency and type (split or single beam). When the EY 500 program is in the start-up mode, it will read this signature and fetch the parameters corresponding to the installed transceiver. There are several transducer types associated with each frequency, and a list of the relevant transducers is displayed in the Transducer Type submenu. Here the operator must select the transducer type connected to the system. The above Transceiver Menu shows the default parameters of a 38 kHz split-beam transceiver.

When the transducer type is selected in the Transducer Type submenu, the default parameters will come up in the Transceiver Menu. There may be differences between the default values and the measured transducer values. Each transducer delivery includes a data sheet with measured parameter values for that specific transducer. These values should be entered after starting up the EY 500 for the first time.

The Sv and TS transducer gains may be decided by means of a calibration routine. Refer to the section "Installation, System Test and Calibration".

Mode Options:

OFF
ACTIVE
PASSIVE
TEST

The transceiver is OFF, ACTIVE (normal operation), PASSIVE (normal operation but with the transmitter disabled) or in TEST mode (a test tone is inserted in the receiver front end, the transmitter is disabled).

Transducer Type Options:

ES38B
ES38-12
ES38
ES38D
ES38-5
OTHER

The list of transducers above depends on the signature read from the transceiver. The transducer type connected to the system should be selected. When set to OTHER, the operator may enter the relevant specifications if a non-standard transducer is to be used.

Transd. Sequence Options:

OFF
ON

This operation requires special hardware supplied by Simrad. Up to 32 transducers can be used in a multiplexing scheme.

The procedure for Transd. Sequence is:

1. Set Transd. Sequence to ON
   This brings forth the following submenu:

Number	1
State	On
No. of Ping	1
Depth	0.00 m

Number is the transducer number and may be set from

1 to 32.

State will enable the transducer for sequencing if ON and disable the transducer if OFF.

No. of Ping is set to the number of pings before moving to the next transducer in the sequence.

Transducer *Depth* may be set for each transducer according to the physical system setup.

Note that the transducer type and transducer parameters may be set individually for each transducer number.

Transducer Depth Options:

0.00 to 999.99 m in steps of 0.01 m

Installation depth of transducer, relative to the sea surface.

Absorption Coef. Options:

0 to 300 dB/km in steps of 1 dB/km

Absorption of sound in the sea. (Refer to section "Theory of Operation" for more information about the absorption coefficient, also called attenuation constant and absorption loss).

The default values are computed according to Francois and Garrison, J. Acoust. Soc. Am. 72(6), December 1982.

* 10 degrees | Celsius
* 35 parts per thousand salinity
* 250 meter depth
* pH = 8

Pulse Length

Options:

SHORT
MEDIUM
LONG

You may select between three different pulse lengths (pulse durations). A short pulse length gives a better vertical resolution while a long pulse length is used to increase the detection range.

There is a close connection between choice of pulse length and choice of bandwidth. See Bandwidth description below.

Bandwidth

Options:

NARROW
WIDE
AUTO

Your may select between WIDE and NARROW manual bandwidth, or AUTO for automatic selection.
A narrow bandwidth results in little noise, but a poor pulse response. A wide bandwidth lets through more noise, but improves the pulse response.

In AUTO the bandwidth is automatically adjusted to the pulse length:

- WIDE bandwidth for Short and Medium pulse length
- NARROW bandwidth for Long pulse length.

Please observe that NARROW bandwidth should not be used in combination with Short and Medium pulse length.

Wide bandwidth is approximately 1/10 of the frequency. Narrow bandwidth is approximately 1/100 of the frequency.

Max. Power Options:

0 to 10,000 W in steps of 1 W

Transmit power referred to the transducer terminals. This setting only affects the value for Pt used in the computations, not the actual power going out. Refer to paragraph POWER BUDGET in the section "Theory of Operation".

2-Way Beam Angle Options:

-99.9 to 0.0 dB in steps of 0.1 dB

Equivalent two-way beam opening solid angle.

Refer to paragraph POWER BUDGET in section "Theory of Operation".

Sv Transd. Gain Options:

0.00 to 99.99 dB in steps of 0.01 dB

Peak transducer gain assumed during computation of volume backscattering strength. Refer to paragraph POWER BUDGET in section "Theory of Operation".

TS Transd. Gain Options:

0.00 to 99.99 dB in steps of 0.01 dB

Peak transducer gain assumed during computation of target strength.

Refer to paragraph POWER BUDGET in section "Theory of Operation".

Angle Sens. Along

Options:

0.0 to 100.0 in steps of 0.1.

Angle sensitivity in the fore-and-aft direction. Angle sensitivity of split-beam transducer = electrical angle in degrees for one mechanical angle in degrees.

Refer to paragraph SPLIT BEAM OPERATION in section "Theory of Operation".

Angle Sens. Athw.

Options:

0.0 to 100.0 in steps of 0.1.

Angle sensitivity in the athwartships direction. Angle sensitivity of split-beam transducer = electrical angle in degrees for one mechanical angle in degrees.

Refer to paragraph SPLIT BEAM OPERATION in section "Theory of Operation".

3 dB Beamw. Along

Options:

0.0 to 99.9 degrees in steps of 0.1 degree.

3 dB beamwidth of transducer in the fore-and-aft direction.

Refer to paragraph SPLIT-BEAM OPERATION in section "Theory of Operation".

3 dB Beamw. Athw.

Options:

0.0 to 99.9 degrees in steps of 0.1 degree.

3 dB beamwidth of transducer in the athwartships direction.

Refer to paragraph SPLIT-BEAM OPERATION in section "Theory of Operation".

Alongship Offset Options:

-9.99 to +9.99 degrees in steps of 0.1 degree.

Mechanical offset angle in the fore-and-aft direction. Refer to paragraph SPLIT-BEAM OPERATION in section "Theory of Operation".

Athw.ship Offset Options:

-9.99 to +9.99 degrees in steps of 0.1 degree.

Mechanical offset angle in the athwartships direction. Refer to paragraph SPLIT-BEAM OPERATION in section "Theory of Operation".

2.6 THE BOTTOM DETECTION MENU

```
  Bottom Detection Menu

Minimum Depth      0.0 m
Maximum Depth        x m
Min. Depth Alarm   0.0 m
Max. Depth Alarm     0 m
Bottom Lost Al.      Off
Minimum Level    -50 dB
```

The Bottom Detection Menu contains choices for setting up the range of the bottom detection algorithm and minimum and maximum depth. It also contains choices for alarm settings and value for minimum bottom echo level. Refer to paragraph BOTTOM DETECTION in section "Theory of Operation". Setting minimum and maximum depths to 0 will disable the bottom detector and will be important when pinging horizontally. Layers should then be of pelagic type since the latter do not require bottom depth detection.

Minimum Depth Options:

0.0 to 4,999.9 m in steps of 0.1 m

Minimum depth for the bottom detection algorithm.

The bottom detector algorithm uses the minimum and maximum depth settings to limit the range of interest for finding the real bottom. Very often the default values will not correspond with the presumed depth pattern in the area of surveying. Therefore, to speed up computations, you may enter the best values according to the expected depth.

Maximum Depth Options:

0 to 5,000 m in steps of 1 m

Maximum depth for the bottom detection algorithm. The default value depends on the transducer installed. A depth setting of 0 m disables the bottom detection algorithm. See Minimum Depth description above.

Min. Depth Alarm Options:

0.0 to 4,999.9 m in steps of 0.1 m

Alarm when detected depth is shallower than depth setting. A depth setting of 0.0 meter disables the alarm.

Max. Depth Alarm Options:

0 to 5,000 m in steps of 1 m.

Alarm when detected depth exceeds depth setting. A depth setting of 0 meter disables the alarm.

Bottom Lost Alarm Options:

OFF
ON

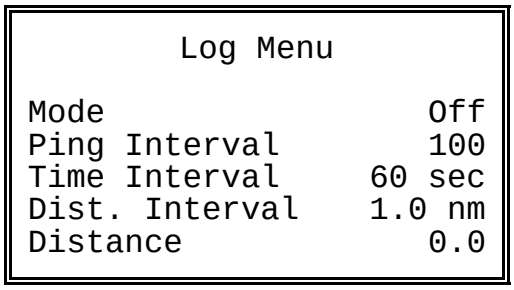
Alarm when bottom detection is lost.

Minimum Level Options:

-80 dB to 0 dB in steps of 1 dB.

After bottom detection, the detected depth is decremented in sample steps until the received echo signal (volume backscattering strength) is below the MINIMUM LEVEL setting. Refer to paragraph BOTTOM DETECTION in section "Theory of Operation".

2.7 THE LOG MENU



The purpose of the Log Menu is to set the intervals between each final calculation of Sa and TS values. The intervals can be based on pings, time or distance.

A log distance counter is displayed at the bottom of the menu and is active only in SPEED mode.

Note that during a log interval it is possible to set the mode to OFF and then initiate outputs of the log result. This is useful when uneven distance intervals are needed.

Mode

Options:

OFF
PING
TIME
SPEED
REPLAY

The log mode is either OFF, based on PING or TIME interval, or SPEED (set in the Navigation Menu) or REPLAY. The log mode must be in any position but OFF in order to get Sa and TS tables. Also the TS distribution bar chart in the TS detection menu needs the log to be operative. Common for all intervals in the Log Menu is the end of a measuring period and the calculation of Sa and TS tables.

In REPLAY, the speed information is filtered from the file being replayed.

Ping Interval

Options:

10 to 10000 in steps of 1

The averaging interval (along the path travelled by the vessel) used by the statistical algorithms are entered in units of number of pings.

Time Interval

Options:

10 to 3600 seconds in steps of 1 second

The averaging interval (along the path travelled by the vessel) used by the statistical algorithms are entered in units of seconds.

Dist. Interval

Options:

0.1 to 10.0 nautical miles in 0.1 nm intervals

The averaging interval (along the path travelled by the vessel) used by the statistical algorithms are entered in units of nautical miles.

Only in SPEED mode!

Distance

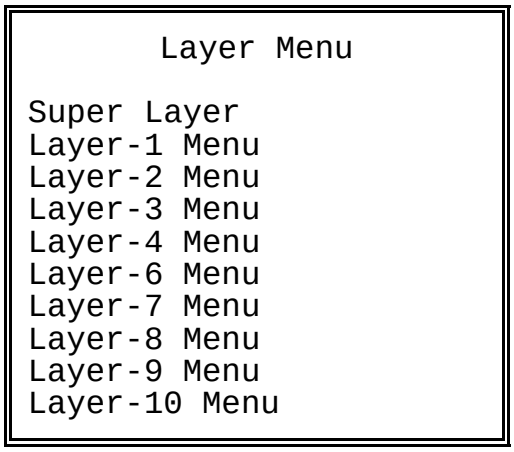
Options:

0 to 9999.9 nm in steps of 0.1 nm.

Sets the EY 500 internal log distance counter. The counter is typically set according to the vessel's log. The log distance counter is displayed at the bottom of the menu.

Only in SPEED mode!

2.8 THE LAYER MENU



Much of the processing of the EY 500 is related to layers in the water volume. The layers are either referred to the sea surface or referred to the detected bottom, and only pings with a successful bottom detection are processed, except if the layer type is pelagic. For measurements in deep waters, or horizontal pinging, a pelagic layer type is provided, which is referred to the transducer face with processing of all pings whether bottom detection is successful or not. A maximum of ten layers can be defined, and overlapping layers are allowed.

The EY 500 performs independent echo integration and size distribution processing (applies to split-beam transceiver only) within each layer. Size distribution and echo integration tables may be printed by the printer and stored on hard disk. However, for one of the layers, the super layer, also a graphical presentation on the display is available; a bar chart showing the size distribution and an inclined line showing the buildup of the integrator. The super layer status can be attached to any of the ten layers, but only to one at a time. The output of sample data and scope plots is also controlled by the super layer settings. Only sample data inside the super layer is output in sample mode, and the start of a scope plot coincides with the start of the super layer.

The computation of statistical parameters (size distribution and echo integration) is based on averaging along the path travelled by the vessel. The averaging interval is often referred to as the log interval. The start and the stop of the averaging interval are common to all layers. The averaging interval is set from the Log Menu.

Super Layer

Options:

0 to 10 in steps of 1

The super layer status is attached to one of the ten layers. Various special functions are related to this layer:

- TS bar chart on display
- fish behaviour window on display
- integration line on display and printer
- SCOPE on printer and display

The super layer is shown with red layer lines on the display and the printer. All super layer functions are disabled when set to zero.

2.8.1 The Layer Submenus

```
      Layer-x  Menu

Type                    Off
Range                50.0 m
Range Start             x m
Margin                 1.0 m
Sv Threshold          -80 dB
```

Default range start value depends on layer number.

For description of layers, refer to description in the previous paragraph.

Type Options:

OFF
SURFACE
BOTTOM
PELAGIC

A layer is either OFF, referred to the sea SURFACE (bottom detection required for integration and TS measurements), referred to the detected BOTTOM, or PELAGIC (referred to the sea surface but with no bottom detection required). The pelagic type should be used in deep waters when no bottom detection is available, and when pinging horizontally.

Range Options:

0.0 to 1000.0 m in steps of 0.1 m.

Thickness of layer. Should be minimum 2 sample intervals.

Range Start

Options:

-10.0 to +9999.9 m in steps of 0.1 m.

The upper depth limit of the layer is either referred to the sea surface (positive values below the surface) or to the detected bottom (positive values above the bottom).

Margin

Options:

0.0 to 10.0 m in steps of 0.1 m.

The margin parameter causes a surface layer to stop at the margin distance above the detected bottom and a bottom layer to stop at the margin distance below the transducer face. In pelagic layer type this parameter is ignored.

Sv Threshold

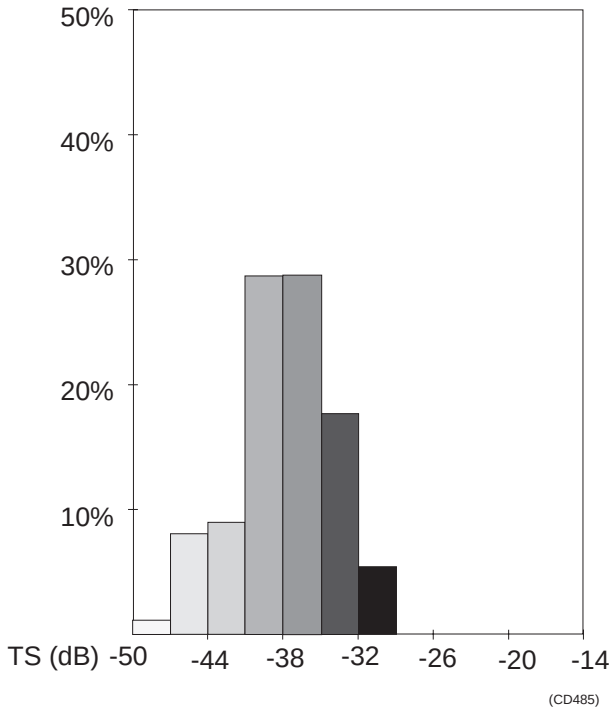
Options:

-100 to 0 dB in steps of 1 dB

Volume backscattering strength threshold value for echo integration. Refer to paragraph ECHO INTEGRATION in section "Theory of Operation".

2.9 THE TS DETECTION MENU

Single fish detections inside the super layer are displayed as a TS bar chart, which is updated every log interval. An example is shown below. The bar colours correspond to echogram colours only when the Min. Value in the TS Detection Menu is equal to TS Colour Min. in the Echogram Menu.



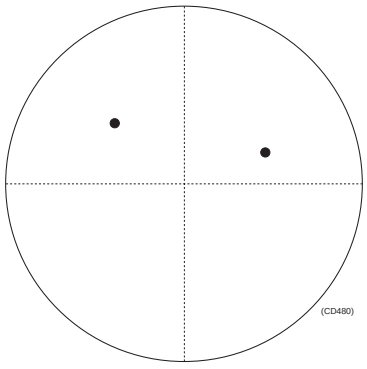
The shape of the fish behaviour window will be either circle or elliptical depending on the transducer selected.

2.9.1 The TS Detection Submenu

```
        TS-Detection

Min. Value          -50 dB
Min. Echo Length      0.8
Max. Echo Length      1.5
Max. Gain Comp.    4.0 dB
Max. Phase Dev.       4.0
```

Refer to paragraph SPLIT BEAM OPERATION in section "Theory of Operation".

Single fish detections inside the super layer are displayed in a fish behaviour window. In addition, data related to the strongest single echo is displayed numerically. The figure below shows the position of two fishes in the sound beam, seen from above. Up to 30 fish echoes may be displayed simultaneously.



Depth	16.30m
TS compensated	-37.0 dB
TS uncompensated	-39.0 dB
Angle along	0.8 dg
Angle athwart	2.1 dg

Min. Value Options:

-100 to 0 dB in steps of 1 dB.

The threshold value for single echo detections. Also lower boundary for the computation of TS distribution classes in the TS tables.

Min. Echo Length Options:

0.0 to 10.0 in steps of 0.1.

For a single echo detection to occur the normalized echo length (echo length between the 6 dB points relative to the peak value divided by the duration of the transmitted pulse) must exceed this parameter.

Max. Echo Length Options:

0.0 to 10.0 in steps of 0.1.

A single echo detection requires the normalized echo length to be less than the max echo length setting.

Max. Gain Comp Options:

0.0 to 6.0 dB in steps of 0.1 dB.

The correction value returned from the transducer gain model must not exceed the max gain compensation setting. (This is the one-way max. gain compensation, the two-way max. compensation will be 12 dB).

All echoes outside the angle corresponding to the chosen gain compensation are skipped. Thus one can reduce the sample volume (beam angle) by choosing a lower value for max. gain compensation.

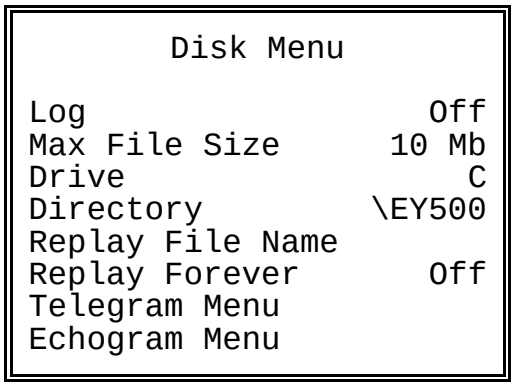
Max. Phase Dev Options:

0.0 to 10.0 in steps of 0.1.

Average electrical phase jitter between samples inside an echo pulse must not exceed the max phase deviation setting where max phase deviation is set in units of phase steps (64 phase steps = 180 electrical degrees).

This parameter controls one of several mechanisms for isolating echoes from single fish. Recommended setting is 2 - 3 for normal conditions. For weak echoes in noisy conditions one should allow more jitter (4 - 10).

2.10 THE DISK MENU



The Disk Menu is used to turn the logging to disk ON/OFF, to choose maximum file size, disk drive, the directory path, the name of the file to be replayed, and to select the Telegram Menu and the Echogram Menu. The Max. File Size setting is used for defining the limit of the file containing the current data telegrams. The Telegram Menu is used to select which data to be sent to the disk. The Echogram Menu is used to set up the echogram to be sent to disk.

Log

Options:

OFF
ON

When LOG is ON, selected telegrams will be written to a file on the disk. The name of this file is automatically given at creation time. When the current file reaches the maximum size set in the MAX. FILE SIZE submenu, the file is closed and the next file is created. The file is stored in the directory selected by the DIRECTORY command.

Max. File Size

Options:

1 Mb
2 Mb
5 Mb
10 Mb
20 Mb

50 Mb
100 Mb

Refer to description under Log (above).

Drive

Options:

A through Z

To select the drive to be used for logging or replaying.

Directory

Options:

To select the directory path to be used for logging or replaying. The path may include several subdirectory levels. Both the / and the \ may be used in the path name.

Replay File Name

Options

To select the file to be replayed.

Replay Forever

Options

OFF
ON

When set to ON, the file being replayed will start anew each time it is finished.

2.10.1 The Disk/Telegram Menu

DISK/Telegram Menu	
Sample Range	0 m
Status	Off
Parameter	Off
Annotation	Off
Navigation	Off
Depth	Off
Echogram	Off
Echo-Trace	Off
Sv	Off
Sample Angle	Off
Sample Power	Off
Sample Sv	Off
Sample TS	Off
Vessel-Log	Off
Layer	Off
Integrator	Off
TS Distribution	Off

The DISK/Telegram Menu is used to select which data is to be sent to the disk. The selected data is collected in a file which has the file name setup described in paragraph 1.4.

The sample range sets the total range per ping for the sample data telegrams.

The following table lists the contents of each telegram. Common for all telegrams is a 4-byte integer value header containing the number of bytes in the current telegram.

All telegrams contain number of bytes in the telegram, header, time (hour, minute, second, hundredth). Some telegrams include the date (year, month, day).

A detailed telegram description is given in section "Description of Telegrams and Remote Control".

Telegram type	Iden-tifier	Recom-mended for EP 500	Recom-mended for replay	Contents
Sample Range			*	Max. range for collecting sample data.
Status	ST			Error, warning or alarm message
Parameter	PE	*		Parameter enter or parameter request output telegram
Annotation	CS	*	*	Annotation output telegram.
Navigation	GL	*	*	Navigation output telegram
Depth	D1	*		Detected bottom depth (m)
Echogram	Q1	*		TVG type, detected bottom depth (m), upper depth of pelagic echogram (m), number of pelagic echogram data points, upper depth of bottom echogram (m), lower depth of bottom echogram (meter), number of bottom echogram data points and echogram data.
Echo-Trace	E1	*		Number of echo-traces (single-fish detections), target depth (m), compensated TS (dB), uncompensated TS (dB), alongship angle (degree), athwartships angle (degree)
Sv	S1			Layer identifier (1-10), mean Sv per ping within layer (dB), mean effective thickness of layer (meter),
Sample Angle	B1		*	Sample angle data (max. 10000 samples). Only used in split-beam system.
Sample Power	W1		*	Sample power data (max. 10000 samples)
Sample Sv	V1			Sample Sv data (max. 10000 samples)
Sample TS	P1			Sample TS data (max. 10000 samples)
Vessel-Log	VL	*	*	Vessel log distance (nautical miles)
Layer	LL	*		Super layer identifier (1-10), number of active layers, layer limits for each layer
Integrator	A1	*		Integrator data
TS Distribution	H1	*		Lower boundary of TS range (dB), number of detections within layer, detections per TS class (%)

Table 1. Telegram types.

2.10.2 The Disk/Echogram Menu

```
   DISK/Echogram Menu

Range              100 m
Range Start          0 m
Auto Range         Off
Bottom Range        15 m
Bot. Range Start    10 m
No. of Main Val.    250
No. of Bot. Val.     75
TVG             20 log R
```

The DISK/Echogram Menu is used to set up the echogram to be sent as a telegram to the hard disk.

Range

Options:

1 m 250 m
5 m 500 m
10 m 1000 m
15 m 1500 m
25 m 2500 m
50 m
100 m
150 m

Depth range across echogram.

Range Start

Options:

0 to 2500 meters in steps of 1 m

Upper start depth of echogram.
This parameter is only significant while Auto Range is OFF.

Auto Range Options:

OFF
ON

Automatic adjustment of Range Start aimed at maintaining the bottom echo inside the echogram. Auto Range ON implies that the Range Start value has no significance.

Bottom Range Options:

0 to 100 m in steps of 1 m.

Range of bottom echogram.

Bot. Range Start Options:

-100 m to +100 m in steps of 1 m.

This command sets the upper start depth of bottom echogram relative to detected bottom depth; positive values above the bottom and negative values below the bottom.

No. of Main Val. Options:

0 to 700 in steps of 1.

Resolution of main echogram range (number of main echogram values).

No. of Bot. Val. Options:

0 to 500 in steps of 1.

Resolution of bottom echogram range (number of bottom echogram values).

TVG

Options:

20 log R
40 log R

This parameter controls which transmission loss compensation algorithm is to be used (TVG = Time Variable Gain). 20 log R is selected for echogram presentation of volume back-scattering strength, and 40 log R for presentation of target strength.

For postprocessing with integration, 20 log R should be chosen.

2.11 THE SERIAL COMMUNICATION MENU

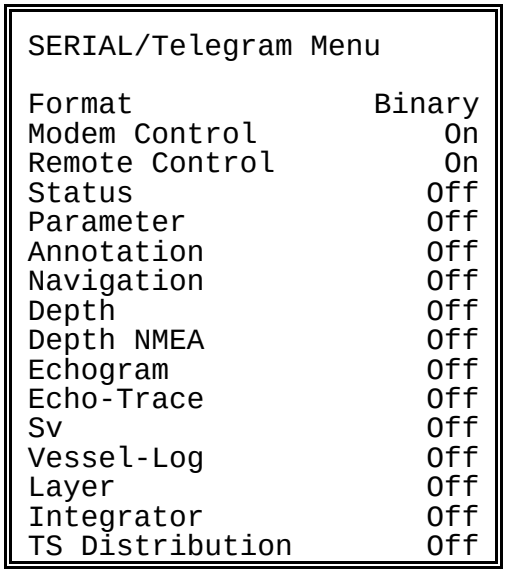
```
  SERIAL COM. MENU

Telegram Menu
USART Menu
Echogram Menu
```

This menu is used for entry to the different Serial Communication submenus.

The default COM2 port on the PC is used for this serial line input/output. COM1 is used for navigation input. Switching between COM1 and COM2 can be done in the Utility Menu (COM1/COM2 switch).

For more information, refer to the section "Description of Telegrams and Remote Control".

2.11.1 The SERIAL/Telegram Menu



This menu basically controls the composition of output data telegrams on the serial port. For details about telegrams, refer to section "Description of Telegrams and Remote Control".

Format

Options:

ASCII
Binary

To select ASCII or binary format for output telegrams. The formats are described in detail in the section "Description of Telegrams and Remote Control".

If on-line EP 500 is used for reading EY 500 data on serial line, the binary format must be chosen.

Modem Control Options:

OFF
ON

To enable modem data transfer.
When Modem Control is ON, a command string for enabling of "auto answer mode" is sent. This enables the echo sounder to be called remotely and for data to be transferred through the telephone network.

Remote Control Options:

OFF
ON

Ignore or interpret input telegrams.

Status Options:

OFF
ON

Error/warning/alarm output telegram.

Parameter Options:

OFF
ON

Parameter enter and parameter request output telegram.

Annotation Options:

OFF
ON

Annotation output telegram.

Navigation Options:

OFF
ON

Navigation output telegram.

Depth Options:

OFF
ON

Detected depth output telegram.

Depth NMEA Options:

OFF
ON

Detected depth output NMEA telegram.

Echogram Options:

OFF
ON

This output telegram may be used by postprocessing systems (e.g. EP 500 or BI 500) and allows an entire cruise to be replayed off line on a general purpose computer.

Echo-Trace Options:

OFF
ON

Single echo detection output telegram.

Sv Options:

OFF
ON

Output telegram containing mean volume backscattering strength per ping within each of the layers.

Vessel-Log Options:

OFF
ON

Output telegram reporting that a simulated log pulse has been detected. Typically, there are 200 pulses per nautical mile generated in simulated vessel speed.

Layer Options:

OFF
ON

Output telegram containing the layer parameter settings every averaging interval.

Integrator Options:

OFF
ON

Output telegram containing echo integration results for every averaging interval.

TS Distribution Options:

OFF
ON

Output telegram containing TS distributions for every averaging interval.

2.11.2 The SERIAL/USART Menu

```
SERIAL/USART Menu

Baudrate          9600
Bits Per Char.       8
Stop Bits            1
Parity            None
```

This menu is used to set up baudrate, bits per character, number of stop bits and parity for serial telegrams.

Baudrate Options:

300 *9600*
600 *19200*
1200 *38400*
2400 *57600*
4800 *115200*

Baudrate in bits per second (RS232 port).

Bits per Char Options:

7 *8*

Number of bits per character (RS232 port).

Stop Bits Options:

1 *2*

Number of stop bits (RS232 port).

Parity Options:

NONE
ODD
EVEN

Type of parity (RS232 port).

2.11.3 The SERIAL/Echogram Menu

```
    SERIAL/Echogram Menu

Range                    100 m
Range Start                0 m
Auto Range               Off
Bottom Range              15 m
Bot. Range Start          10 m
No. of Main Val.           250
No. of Bot. Val.            75
TVG                  20 log R
```

This menu is used to enter settings for echograms to be transmitted via the serial port.

Range

Options:

1 m *250 m*
5 m *500 m*
10 m *1000 m*
15 m *1500 m*
25 m *2500 m*
50 m
100 m
150 m

Depth range across echogram.

Range Start

Options:

0 to 2500 m in steps of 1 m.

Upper start depth of echogram.
This parameter is only significant while Auto Range is OFF.

Auto Range Options:

OFF ON

Automatic adjustment of Range Start aimed at maintaining the bottom echo inside the echogram. Auto Range implies that the Range Start value has no significance.

Bottom Range Options:

0 to 100 m in 1 m steps.

Range of bottom echogram.

Bot. Range Start Options:

-100 m to +100 m in steps of 1 m

This command sets the upper start depth of bottom echogram relative to detected bottom depth; positive values above the bottom and negative values below the bottom.

No. of Main Val. Options:

0 to 700 in steps of 1.

Resolution of main echogram (number of main echogram values).

No. of Bot. Val. Options:

0 to 500 in steps of 1.

Resolution of bottom echogram (number of bottom echogram values).

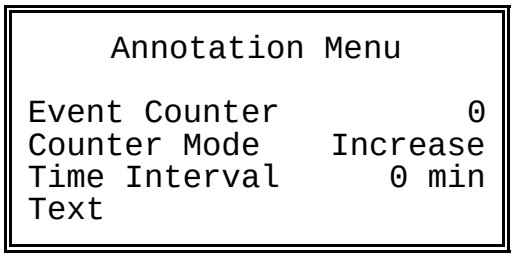
TVG

Options:

20 log R
40 log R

This parameter controls which transmission loss compensation algorithm is to be used (TVG = Time Variable Gain). 20 log R is selected for echogram presentation of volume backscattering strength, and 40 log R for presentation of target strength.

2.12 THE ANNOTATION MENU



The Annotation Menu contains the possibilities of entering event count numbers, choosing the time between date/time annotations and inserting text to be stored and/or printed.

Event Counter Options:

0 to 10,000 in steps of 1.

Entering an event count number causes an event with the selected number. Hence, events can be generated from the menu just by entering the current event counter value.

An event results in a red vertical line across the echogram on display and printer, if the event marker parameter in the DISPLAY/PRINTER Menu is ON. On the printout is also included the current event number.

Counter Mode Options:

Increase
Decrease.

This command makes it possible to choose between increasing or decreasing the event number each time an event is generated.

Time Interval Options:

0 to 60 minutes in steps of 1 minute.

Entering a value of n minutes will cause a date/time annotation to occur every nth minute. A value of 0 disables the function.

Text Selecting this entry results in a cursor for start of input of text. Maximum length of text string is 80 characters. Input is terminated by pressing the ENTER key.

2.13 THE NAVIGATION MENU

```
    Navigation Menu

Navig. Input      SERIAL
Start Sequence    $GPGLL
Separation Char.    002C
Stop Character      000D
First Field No.        2
No. of Fields          4
Speed Input       Manual
Manual Speed   10.0 knt
Baudrate            4800
Bits Per Char.         8
Stop Bits              1
Parity              None
```

The decoding of navigation input telegrams is based on the recognition of a start sequence, a field separation character and a stop character. The "useful" substring within the total telegram is identified by specifying the position of the first field and the number of fields to be included in the navigation data substring.

In the start sequence up to 6 start characters may be defined. However, if there is no trouble with ambiguity, some of the characters may be set to ? which indicates "don't care" to test against equality.

NMEA 0183 navigation telegrams are properly interpreted using the default settings shown above. Assuming the NMEA 0183 telegram

$GPGLL,4728.31,N,12254.25,W<CR><LF>

the "useful" navigation data substring becomes

4728.31,N,12254.25,W

Note that <CR> denotes carriage return and <LF> denotes linefeed.

The useful part of the incoming navigation telegrams is continuously displayed when the Navigation Menu is selected.

The navigation port default may be configured for different baudrates and communication protocols. It is possible to switch between COM1 and COM2 using the COM1/COM2 Switch in the Utility Menu.

Refer to the end of this paragraph for a table showing ASCII characters versus hexadecimal representation

Navig. Input Options:

OFF
SERIAL

To select the source of navigation input. OFF disables input of navigation telegrams.

Start Sequence Options:

0020h to 007Fh.

First characters of telegram.
Up to 6 characters to be set in a sequence.
The ? sign indicates a don't care character.

Separation Char Options:

0000h to 007Fh.

Field separation character.
("," corresponds to ASCII 2C hex)

Stop Character Options:

0000h to 007Fh.

Last character of telegram.
(<LF> corresponds to ASCII 0A hex)

First Field No. Options:

1 to 100 in steps of 1.

Position of first field of navigation data substring.

No. of Fields Options:

1 to 100 in steps of 1.

Number of fields to be included in navigation data substring.

Speed Input Options:

MANUAL
SERIAL

The speed input may be received via the serial port or set manually (see Manual Speed).

Manual Speed Options:

0.0 to 25.0 knots in steps of 1 knot

To set manual speed.

If Log Menu/Log Mode is set to SPEED, the Manual Speed should be set to a number greater than zero to obtain log intervals.

Baudrate Options:

300 *4800*
600 *9600*
1200 *19200*
2400

Baudrate in bits per second (navigation port).

Bits per Char. Options:

7 *8*

Number of bits per character (navigation port).

Stop Bits Options:

1 2

Number of stop bits (navigation port).

Parity Options:

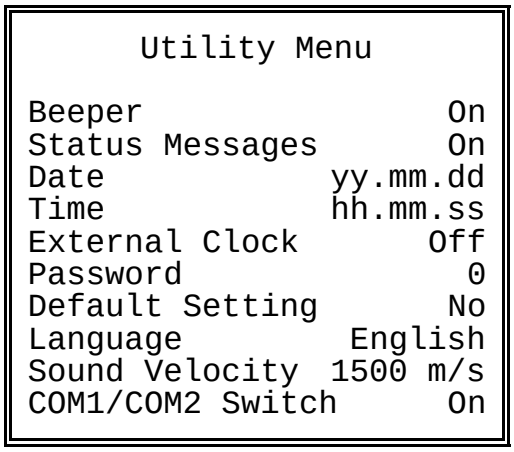
NONE
ODD
EVEN

Type of parity (navigation port).

ASCII CHARACTERS VERSUS HEXADECIMAL REPRESENTATION

	0x	1x	2x	3x	4x	5x	6x	7x
x0	NUL	DLE	space	0	@	P	`	p
x1	SOH	DC1	!	1	A	Q	a	q
x2	STX	DC2	"	2	B	R	b	r
x3	ETX	DC3	#	3	C	S	c	s
x4	EOT	DC4	$	4	D	T	d	t
x5	ENQ	NAC	%	5	E	U	e	u
x6	ACK	SYNC	&	6	F	V	f	v
x7	BEL	ETB	'	7	G	W	g	w
x8	BS	CAN	(	8	H	X	h	x
x9	HT	EM	)	9	I	Y	i	y
xA	LF	SUB	*	:	J	Z	j	z
xB	VT	ESC	+	;	K	[	k	{
xC	FF	FS	,	<	L	\	l	|
xD	CR	GS	-	=	M	]	m	}
xE	SO	RS	.	>	N	^	n	~
xF	SI	US	/	?	O	_	o	DEL

2.14 THE UTILITY MENU



The Utility Menu contains different commands, like Beeper ON/OFF, Default settings YES/NO etc.

Beeper Options:

OFF
ON

Beeper ON/OFF. The beeper outputs short sound signals for status messages/warnings and long tones for alarms.

Status Messages Options:

OFF
ON

Enables/disables error, warning and alarm messages on the display.

Date Year, month and day are entered as a triplet into the PC internal clock (battery backup power).

Time Hour, minute and second are entered as a triplet into the PC internal clock (battery backup power).

External Clock Options:

OFF
SERIAL

This command synchronizes the echo sounder with external clock via the serial port.

Password Options:

0 to 9999.

A password number in the range 0 to 9999 can be entered. The menu system is blocked until the selected password is re-entered.

Default Settings Options:

NO
YES

Simrad default settings are entered for all parameters when specifying YES.

Language Options:

ENGLISH
FRENCH
GERMAN
NORW.

To choose between English, French, German or Norwegian menu texts.

Sound Velocity Options:

1400 to 1700 m/s in steps of 1 m/s

The sound velocity in the sea varies with temperature, salinity and pressure. The default value assumes a constant velocity of 1500 m/s for all depths.

Note that the echogram will be velocity compensated.

Refer to the sound velocity diagram in section "Calibration".

COM1/COM2 Switch

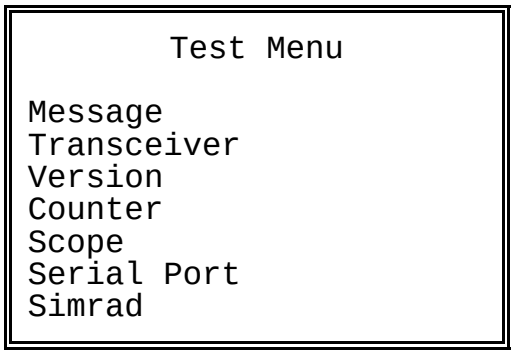
Options:

OFF
ON

If OFF is selected:
COM1 = navigation input
COM2 = remote control/telegrams

If ON is selected:
COM1 = remote control/telegrams
COM2 = navigation input

2.15 THE TEST MENU



The Test Menu is used for checking the receiver response, to display the current version of the EY 500 software, and to display amplitude and phase data of a single ping. The final menu entry is for Simrad personnel only.

Message

Options:

OFF
ON

When Message is set to ON, a test message will be transmitted to the serial communication port COM1.

Example:

```
                phase
     amplitude athwarts.  depth
         ↓        ↓         ↓
XX1:,-110.5,  12,  20,-120.3,167.5,dummy,dummy,
   ↑           ↑      ↑
transceiver  phase  noise
   No.       along
```

Transceiver

This menu entry is primarily used for checking the receiver response. For every ping, the display shows:

- the amplitude (Ampl.) of sample 511 (dBW)
- the fore-and-aft (Alo.) electrical phase of sample 511 (phase steps)
- the athwartships (Ath.) electrical phase of sample 511 (phase steps)
- the background noise level (dBW)

Version. The EY 500 software version is displayed.

Counter The CPU activity is displayed. A large number indicates that there is spare CPU time, and zero implies that the CPU is fully utilized or not running.

Scope This menu entry is used to display sample amplitude data. Start of sample data is referred to the current super layer. The layout is very similar to SCOPE on the printer described in paragraph 2.5.1.

The first parameter to be set is the dynamic range for the plot. The second parameter to be set is the lowest amplitude value to be included in the plot.

Serial Port This menu entry is used to test the serial line communication for COM1 and COM2. The last input and output bytes detected by the interface are shown.

Simrad Simrad use only.

THEORY OF OPERATION

P3403E / 857-160020 / AA062

This section contains some of the theory behind the measurements performed by the EY 500; bottom detection, echogram generation, echo integration and target strength statistics.

Document revisions

Rev	Documentation department		Hardware/Software Design		Project/Product Management	
	Date	Sign	Date	Sign	Date	Sign
A	25.08.95	CL	25.08.95	HS	31.08.95	RB

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Document history

(The information on this page is for Simrad's internal use)

Rev. A Original issue. First edition as module. Was section 4 of P2473E.

1 INTRODUCTION

1.1 GENERAL DESCRIPTION

The EY 500 system performs bottom detection, echogram generation and echo integration, and for split-beam systems also target strength statistics are estimated. This section gives some theory behind this performance.

1.2 THE TRANSCEIVER

The transceiver contains transmitter, receiver and A/D-conversion circuitry.

The receiver does not contain any TVG (Time Varying Gain) function as the EY 500 carries out this function solely in software. Instead, the receiving system is designed as a "power meter" with a large instantaneous dynamic range. Input power levels from -160 dBW to 0 dBW (dB's relative 1 W) are measured to a precision of a fraction of a dB and are output to the signal processor as 16-bit digital words using the dBW scale for numeric representation. The receiver includes one receiving channel for single-beam operation and four matched channels plus phase measurement circuitry for split-beam operation.

1.3 THE SIGNAL PROCESSING

The signal processing is done by software in the PC. It takes care of control of the transmitter/receiver and processing of received data.

The software generates echograms, and estimates physical parameters (depth, volume backscattering strength, target strength etc) from the received signal samples by taking into account instrumental effects, transmission losses and transmitted power.

2 POWER BUDGET

The EY 500 utilizes a sophisticated receiver design which is characterized by a very high amplitude measurement accuracy over the entire dynamic input range (-160 dBW to 0 dBW). The absolute power level of the received signal is measured enabling the EY 500 to estimate volume backscattering strength and target strength in the absolute sense. The estimation algorithm is based on a physical model which accurately accounts for instrumental effects and propagation losses. This model will be outlined in order to assure that the measured output scattering parameters are correctly interpreted.

The radiation and receiving properties of a transducer is traditionally stated in terms of source level, directivity index, receiving response etc. However, the

algorithms of the EY 500 uses the more modern concept of gain in order to facilitate power budget equations. The gain concept is used widely within many fields in physics and is accepted internationally as a convenient measure of the radiation properties.

Gain is defined as the intensity ratio observed at a distant point when using a real transducer and an idealized lossless omni-directional transducer keeping the electrical input power constant (see figure.1).

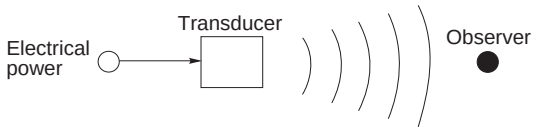

Figure 1 The gain concept.

Thus, gain accounts for both directional properties and losses and is independent of input power level, impedance and observation point. However, gain must be referred to a defined point on the terminal side of the transducer in order to uniquely identify the losses which are to be included. Gain (G) relates to directivity (D) as shown in equation 1:

$$G(\alpha,\beta)=\eta\cdot D(\alpha,\beta) \quad (1)$$

where α and ß are the directional angles, and η is the efficiency of the transducer. Thus, directivity is a normalized quantity which corresponds to the gain pattern of an identical but lossless transducer. Whereas gain is used for describing the radiation properties, it is common to state the receiving properties in terms of the effective receiving area (A).

Gain and effective receiving area are related by reciprocity as shown in equation 2:

$$A = \frac{\lambda^2}{4\pi} G \quad (2)$$

where λ is the wavelength and where A and G are both referred to the same point on the terminal side of the transducer. Figure 2 shows the gain pattern of a typical transducer.

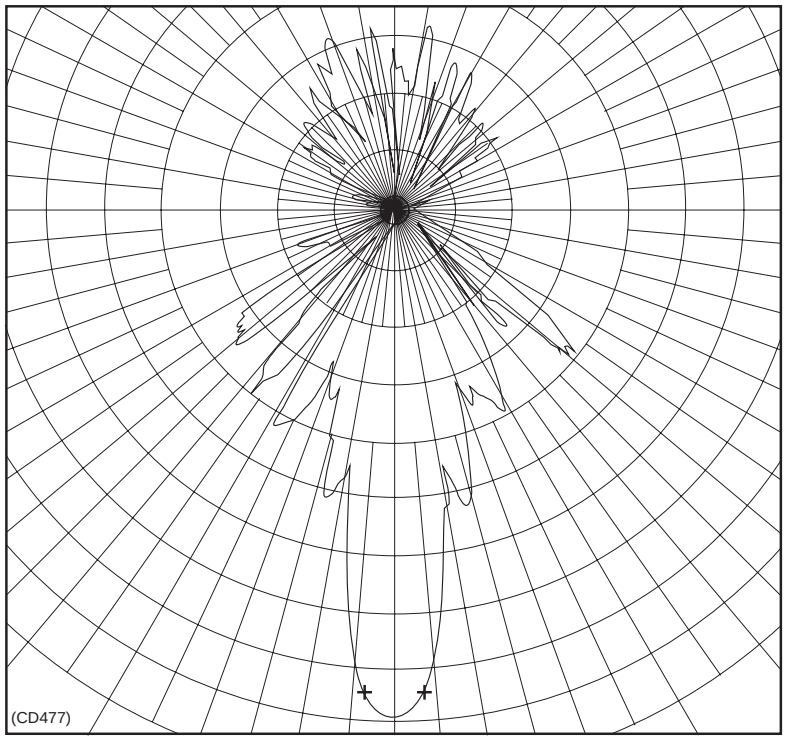

Figure 2 Beam pattern.

The echo from a small object, henceforth the target, is described by equation (3):

$$P_r = P_t G \frac{10^{-\alpha r}}{4\pi r^2} \sigma \frac{10^{-\alpha r}}{4\pi r^2} \frac{\lambda^2}{4\pi} G \quad (3)$$

where

P_r and P_t are the received and transmitted power referred to the transducer terminals.
G is the transducer gain towards the target.
r is the transducer target range.
α is the attenuation constant.
σ is the effective backscattering cross-section area of the target.
λ is the wavelength.

This expression can be recognized as the classic radar equation, and its derivation will be recapitulated.

Assuming an idealized lossless isotropic transducer the transmitted power will propagate evenly in all directions, and the power density at the transducer-target range is explained in expression 4:

$$\frac{P_t}{4\pi r^2} \quad (4)$$

The real transducer amplifies the radiated signal by a factor G in the direction of the target, and attenuation occurs while propagating from the transducer to the target. Hence, the real power density at the target becomes:

$$P_t G \frac{10^{-\alpha r}}{4\pi r^2} \quad (5)$$

The ability of an object to backscatter energy is stated in terms of its effective backscattering cross section area, henceforth the backscattering area, which roughly corresponds to the physical cross section area as seen from the transducer. Introducing this concept in the derivation the real target can be replaced by an isotropic transmitter of power:

$$P_t G \frac{10^{-\alpha r}}{4\pi r^2} \sigma \quad (6)$$

While propagating back towards the transducer attenuation and spherical spreading occur once more, and the power density at the transducer becomes:

$$P_t G \frac{10^{-\alpha r}}{4\pi r^2} \sigma \frac{10^{-\alpha r}}{4\pi r^2} \quad (7)$$

Received power at the transducer terminals is obtained by multiplying this power density by the effective receiving area of the transducer, and the complete equation becomes:

$$P_r = P_t G \frac{10^{-\alpha r}}{4\pi r^2} \sigma \frac{10^{-\alpha r}}{4\pi r^2} \frac{\lambda^2}{4\pi} G \quad (8)$$

Rearranging the terms a simple expression is obtained for calculating the echo properties of the target (equation 9):

$$\sigma = \frac{P_r 64\pi^3}{P_t G^2 \lambda^2} r^4 10^{2\alpha r} \quad (9)$$

In hydroacoustics it is common to state the echo properties in terms of backscattering strength rather than backscattering area, and the equivalent expression for point backscattering strength becomes (equation 10):

$$S_p = \frac{\sigma}{4\pi r_0^2} = \frac{P_r 16\pi^2}{P_t G^2 r_0^2 \lambda^2} r^4 10^{2\alpha r} \quad (10)$$

where r_0 = 1 meter is the reference range for backscattering strength. Finally, the EY 500 implements a logarithmic version of this equation 11:

$$10lg(S_p) = 10lg(P_r) + 10lg(r^4 10^{2\alpha r}) - 10lg(\frac{P_t G^2 r_0^2 \lambda^2}{16\pi^2}) \quad (11)$$

The left-hand side of this equation is commonly referred to as the target strength or simply TS. Thus, target strength is obtained by adding a range dependent term (corresponds to 40-log-r TVG) and a constant (accounts for equipment parameters) to the received signal power (digital word from transceiver/digitizer).

It should be observed that many of the internal algorithms of the sounder are based on the quantity $10\log(S_p)$; TS echogram generation, size distribution statistics etc.

Having established the basic power budget equation for point backscattering, the extension to volume backscattering is straightforward. Whereas scattering from a small object is characterized by its backscattering area, the scattering from a homogeneous volume is characterized by the backscattering area per unit of water volume,$\partial\sigma/\partial V$. The equation for received power becomes (equation 12):

$$P_r = \int_V P_t G \frac{10^{-\alpha r}}{4\pi r^2} \frac{\partial\sigma}{\partial V} \frac{10^{-\alpha r}}{4\pi r^2} \frac{\lambda^2}{4\pi} G \, dV \quad (12)$$

where $\partial\sigma/\partial V dV$ is the backscattering area is from the small volume dV and where integration includes all volume V contributing to the received signal at a particular instant.

With a pulsed transmitter the volume V corresponds to a sphere of thickness $c\tau/2$ where c is the propagation speed in water and τ is the transmit pulse duration. Thus, the three-dimensional integration over V can be replaced by a two dimensional integration over all solid angles 4π ($dV = \frac{1}{2}c\tau r^2 d\Omega$), equation 13:

$$P_r = P_t \frac{10^{-\alpha r}}{4\pi r^2} \frac{\partial\sigma}{\partial V} \frac{10^{-\alpha r}}{4\pi r^2} \frac{\lambda^2}{4\pi} \frac{c\tau}{2} r^2 \int_{4\pi} G^2 d\Omega \quad (13)$$

The equivalent two-way solid beam angle Ψ is a key transducer parameter and is defined (equation 14):

$$\int_{4\pi} G^2 d\Omega = G_0^2 \psi \quad (14)$$

where G_0 is the peak gain. Introducing this definition, rearranging the terms and normalizing with respect to r_0 the expression for volume backscattering strength becomes (equation 15):

$$S_v = \frac{\partial\sigma/\partial v}{4\pi r_0^2} = \frac{P_r 32\pi^2}{P_t G_0^2 r_0^2 \lambda^2 c\tau\psi} \; r^2 10^{2\alpha r} \quad (15)$$

Again, the EY 500 implements a logarithmic version of this equation (equation 16):

$$10\log(S_v) = 10lg(P_r) + 10lg(r^2 10^{2\alpha r}) - 10lg\left(\frac{P_t G_0^2 r_0^2 \lambda^2 c\tau\psi}{32\pi^2}\right) \quad (16)$$

Thus, volume backscattering strength is obtained by adding a range dependent term (corresponds to 20-log-r TVG) and a constant to the received signal power. The quantity $10\log(S_v)$ is used by many of the internal algorithms of the sounder; S_v echogram generation, echo integration, bottom detection etc.

3 EY 500 DB FORMAT

Simple conversion between dB and linear scale is obtained in a computer by using 10 dB x log(2) = 3.0103··· dB as a reference value in the dB domain. The EY 500 algorithms use 16-bit words to represent dB quantities.

A	B
XXXXXXXX	XXXXXXXX

The eight most significant bits (A) correspond to the integer part relative 3.0103··· dB and the eight least significant bits (B) correspond to the fractional part. Thus, the least significant bit corresponds to an increase/decrease of 3.0103··· dB/256 ≈ 0.01 dB. Assuming as an example the linear decimal number 178.125 the value of A and B becomes

10 dB x log(178.125) = 22.507··· dB

22.507···/3.0103··· = 7.4767··· =

A	B
00000111	01111010

Conversion to linear scale is based on the relation

$10^{0.30103\cdots \times A.B} = 2^{A.B} = 2^{A+0.B} = 2^{A} \times 2^{0.B}$

Evidently, the upper byte A is simply the exponent in binary floating point format, and 2 to the power 0.B is the mantissa. Thus, the mantissa can be obtained by using B as the address in an antilog lookup table containing 256 elements, and a similar technique can be used for the inverse conversion from linear to dB scale.

4 BOTTOM DETECTION

The bottom detection algorithm is implemented solely in software. The algorithm is designed with emphasis on reliability in the sense that erroneous depth detections are never output. Whenever uncertainty is associated with a detection the algorithm outputs zero depth to indicate that no reliable detection was obtained. The algorithm is designed to maintain bottom lock for a discontinuous jump in bottom depth, and special features have been included in order to avoid false bottom detection on schools of fish. Operational experience has shown that the algorithm indeed is quite robust; erroneous bottom detections are virtually absent, a dense school of fish does not confuse the algorithm, rough bottom contours cause only a few dropouts to occur.

Basically the algorithm is implemented as a fourfold tracking algorithm. For each ping up to four candidate bottom returns are identified, and their association with previous bottom candidates is determined in order to perform

individual tracking of several potential bottoms simultaneously. For example, bottom return number one could be from a large school of fish, return two from the true bottom, and return three could be the echo which has travelled twice up and down between the surface and the bottom.

In conjunction with echo integration it is vital that the bottom return is not included in the integration process. After bottom detection, therefore, an algorithm is activated which decrements the detected depth in small steps until the received echo signal has vanished. Experience has shown that this last technique substantially improves echo integration near the bottom. However, it should be observed that for an inclined bottom the detected depth tends to be slightly shallower than the true depth along the transducer axis.

5 BOTTOM RANGE

Bottom range is available on the display and on the printer and allows the echogram relative to detected bottom to be shown with a resolution different from that of the main echogram. This feature is useful when studying soft sediment layers and bottom consistency. Waves propagating down into the bottom are strongly attenuated, and echoes from subbottom layers are soon below the dynamic range of the echogram colour scale. Hence, additional amplification (performed in software) brings these echoes into the visible range. Excess amplification is set from the menu system in dB's per meter below the detected bottom. A typical value would be 0.5 dB/m. However, the optimum value will depend on bottom type and frequency and should be found experimentally.

6 ECHO INTEGRATION

The method of echo integration is recognized as an efficient and reliable technique for fish stock assessment. The EY 500 performs integration within independently set depth layers. Basically, the integrator performs integration in the vertical direction within the layers and averaging in the horizontal direction along the path travelled by the vessel. The integration process is based on the quantity $10\log(S_v)$ and is defined by the equations 17, 18 and 19:

$$\frac{\partial \sigma}{\partial V} = 4\Pi r_0^2 S_V \quad (17)$$

$$\frac{\partial \sigma}{\partial A} = \int_{r_1}^{r_2} \frac{\partial \sigma}{\partial V} dr \quad (18)$$

$$\sigma_A = mean\left[\frac{\partial \sigma}{\partial A}\right] \quad (19)$$

The first equation converts volume backscattering strength to backscattering area per unit of volume. The corresponding backscattering area per unit of horizontal area is obtained by integrating over the layer vertically, r_1 to r_2. The output parameter from the integrator each averaging interval σ_A represents the mean backscattering area per unit of horizontal area and is obtained by averaging the individual $\partial\sigma/\partial A$'s over one interval. The quantity s_A (m^2/nm^2) is related to σ_A (m^2/m^2) as:

$$s_A = (1852 m/nm)^2 \sigma_A \quad (20)$$

The algorithm implemented by the sounder is obtained by combining the four equations

$$s_A = 4\pi r_0^2 \cdot mean\ [\int_{r_1}^{r_2} S_V dr] \cdot (1852 m/nm)^2 \quad (21)$$

Calibrating the sounder for the first time with a reference target a small discrepancy will most likely be observed between the measured S_A and the theoretically computed value (refer to section "Installation, System Test and Calibration"). This discrepancy is due to differences between the true and the nominal value of physical parameters; transducer gain, attenuation constant, transmit power etc. Agreement between the echo integrator output and the theoretically computed value is obtained by finetuning the peak transducer gain parameter (equation for volume backscattering strength in paragraph 2). This parameter is set from the menu system in units of dB. Note that different peak transducer gain parameters are used for computing target strength and volume backscattering strength.

To find mean S_v from s_A (equation 22):

$$S_V = \frac{s_A}{4\pi r_0^2 (1852 m/nm)^2 \cdot (r_2 - r_1)} \quad (22)$$

7 SPLIT-BEAM OPERATION

Observation of fish with the EY 500 is based on echo integration for assessment of the total biomass and the split-beam technique for assessment of the size distribution of individuals. Thus, the split-beam feature represents a valuable supplement to echo integration.

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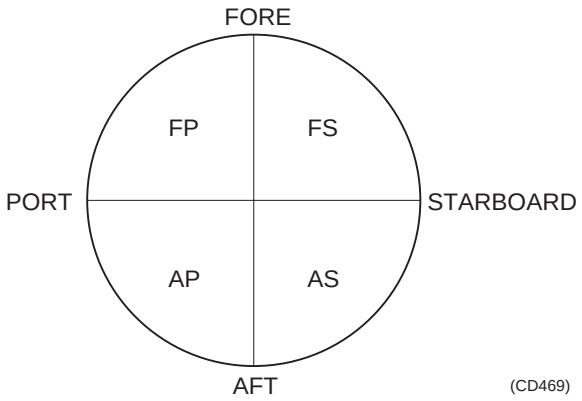

Figure 3 Split-beam transducer.

A split-beam transducer is electrically divided into four quadrants as shown in figure 3. All four quadrants are excited in parallel during transmission. However, the received signal from each quadrant is amplified separately in a four-channel matched receiver allowing the direction of arrival of an echo to be determined. An acoustic wavefront propagating towards the transducer arrives at different times at the four quadrants causing the phase angle of the electrical output signal from the quadrants to differ. The fore-and-aft angle is determined from the electrical phase difference between the fore and the aft transducer halves (the FP+FS signal relative the AP+AS signal), and the athwartships angle from the starboard and port signals (the FS+AS signal relative to the FP+AP signal). The ratio between the electrical and mechanical angle is referred to as the "angle sensitivity" of the transducer (see table under Transceiver Menu in section "Operation").

In figure 4 fish "A" is positioned along the transducer axis where maximum transducer gain occurs, and fish "B" is positioned towards the edge of the beam where the gain is lower. Evidently, the echo signal from fish "A" will be stronger than the signal from fish "B" even though they are of the same size and at the same depth.

Thus, determining fish size from received echo strength alone will not be successful. However, knowing the beam pattern of the transducer and the position of the fish within the beam it is possible to correct for the differences in transducer gain and thereby obtaining the true target strength of the fish.

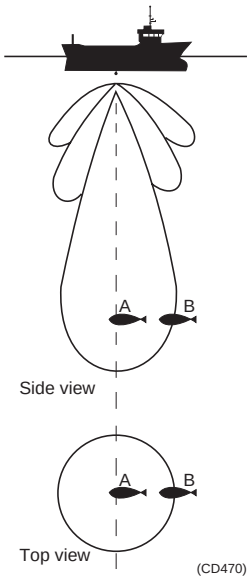

Figure 4 Split-beam principle.

The beam pattern correction in the EY 500 is based upon a model which is described in section "Installation, System Test and Calibration".

The split-beam measurement principle only works for echoes originating from a single point target since the electrical phase will be random if echoes from multiple individuals at different positions in the beam are received simultaneously.

It is essential therefore to distinguish single fish echoes from multiple fish echoes, henceforth the single echo detection algorithm. The algorithm is based on a number of criteria, and some of these can be set from the menu system:

* TS must exceed the min value parameter (default -50 dB).

* The normalized echo length must exceed the min echo length parameter (default 0.8) where normalized echo length is the length between the 6 dB points relative the peak value divided by the duration of the transmitted pulse.

* The normalized echo length must be less than the max echo length parameter (default 1.8).

* The correction value returned by the gain correction model must not exceed the max gain compensation parameter (default 4 dB). Narrow beamwidth for small targets is obtained by using smaller max. gain compensation and should be considered when TS detection is poor.

* Average electrical phase jitter between samples inside an echo pulse must not exceed the max phase deviation parameter (default 2 phase steps) where max phase deviation is set in units of phase steps (64 phase steps = 180 electrical degrees). In a noisy environment or when the targets are small, the max. gain compensation and TS minimum values should be carefully optimized to suit the current situation.

8 IMPULSE RESPONSE

The transmitted signal is characterized by a square-like envelope with zero rise and decay times. However, on its way the signal passes through filters in the transmitter and receiver and twice through the transducer which has a bandpass-like response. The shape of the received signal is therefore different from the transmitted one in the sense that the rise and decay times are no longer zero and the peak amplitude is slightly reduced as shown in figure 5.

The EY 500 corrects for these effects by

* including a small peak amplitude correction factor in the algorithm for point backscattering strength.

* using the effective pulse length rather than the transmitted pulse length in the algorithm for volume backscattering strength.

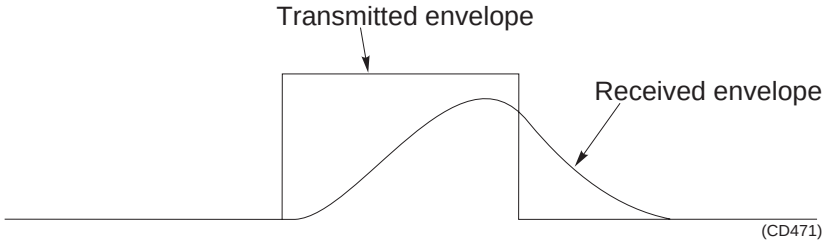

Figure 5 Signal envelopes.

It should be observed that both absolute accuracy and, more important, consistency between TS and echo integration quantities are improved by including these corrections.

9 NOISE

The deep water performance of a sounder is determined by the system noise level; the sum of receiver noise, local noise and ambient noise.

Receiver noise includes thermic noise from the receiver itself and pickup noise from the digital circuitry of the sounder. The EY 500 utilizes a low noise receiver input stage, and the digital noise pickup has been reduced to an insignificant level by proper internal screening. Local noise includes propeller noise, engine noise, flow noise and other locally identifiable acoustic noise sources. Basically, this noise is related to vessel design and transducer installation and can be reduced significantly by taking the necessary precautions.

Ambient noise is the noise of the sea itself. It is that part of the total noise background of the sea which is not due to some locally identifiable source. The ambient noise level is subject to wide variations. Heavy shipping and strong wind increase the noise level, and in shallow water the noise level is typically higher than in deep water.

Noise can in most practical cases be considered "white" with a continuous power

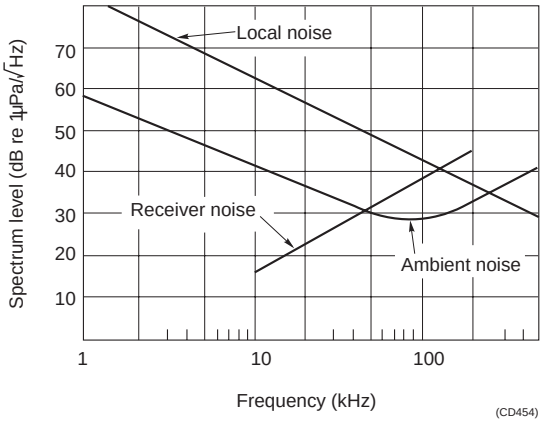

Figure 6 Receiver noise versus ambient noise.

spectral density with respect to frequency. A quantitative evaluation of noise requires that the various contributions are all referred to a common point within the receiving system, and for most purposes it is convenient to use the transducer terminals as the common point. Referred to this point the total system noise is simply the sum of all individual noise power contributions.

The EY 500 provides a unique possibility for checking the noise level of the total installation, and a method of showing the maximum detection depth for a specified target strength. This is achieved by setting the min. TS in the echogram menu equal to a specified TS in passive mode, and the echogram range long enough to show when the noise begins to be displayed. The TS specified can be observed down to a depth just above the depth where the noise is displayed.

10 ABSORPTION COEFFICIENT

The absorption coefficient can be set in the Transceiver submenu. Figure 7 shows the variations of this coefficient for different frequencies and salinities.

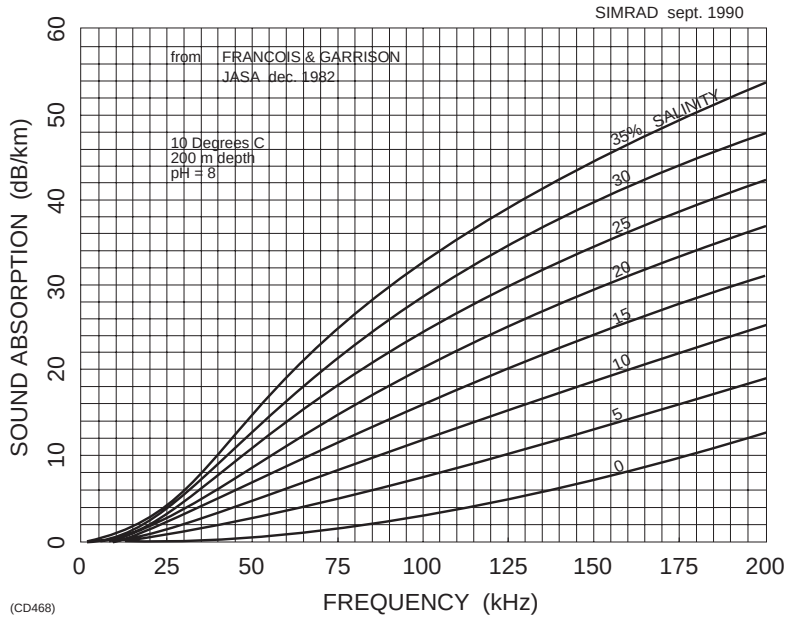

Figure 7 Sound absorption.

11 SOUND VELOCITY

Figure 8 is a diagram showing the sound velocity for different salinities and temperatures.

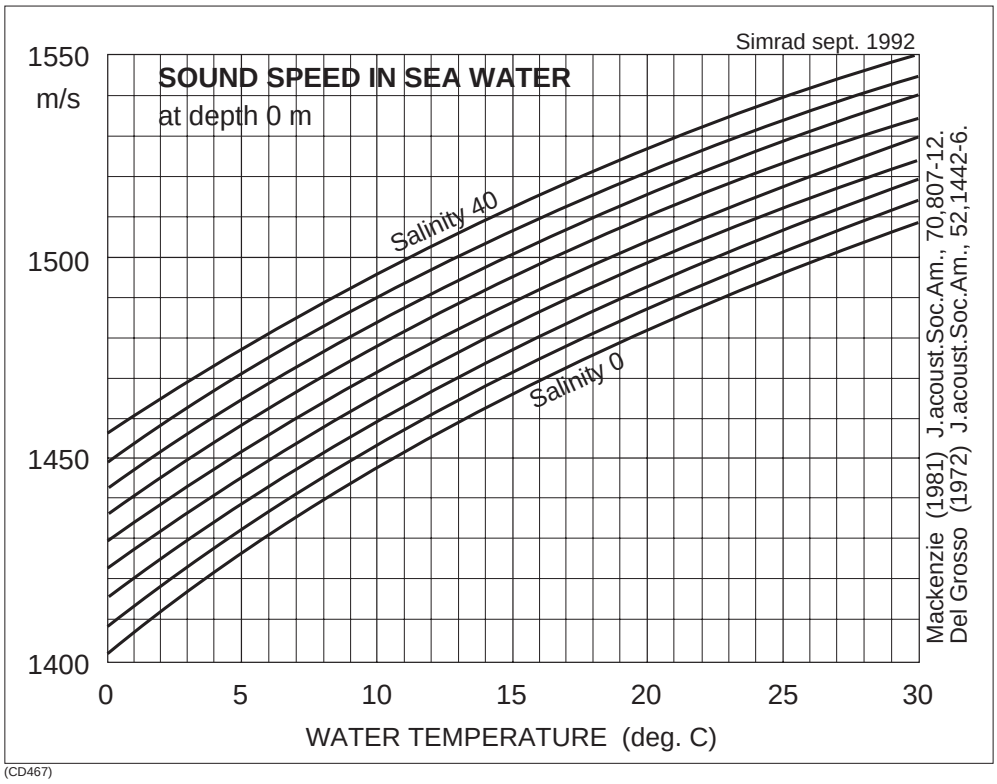

Figure 8 Sound velocity diagram.

DESCRIPTION OF TELEGRAMS AND REMOTE CONTROL

P3404E / 857-160021 /AA062

This section contains information about the serial communication port of the EY 500 and descriptions of the different telegram types.

Document revisions

Rev	Documentation department		Hardware/Software Design		Project/Product Management	
	Date	Sign	Date	Sign	Date	Sign
A	25.08.95	CL	25.08.95	HS	31.08.95	RB

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Document history

(The information on this page is for Simrad's internal use)

Rev. A Original issue. First edition as module. Was section 5 of P2473E.

1 SERIAL COMMUNICATION PORT

1.1 GENERAL

The serial communication port on the EY 500 (default COM2) is of type RS232. Communication parameters such as baud rate, bits per character etc. can be programmed from the Serial/USART Menu. The port may be connected to an external computer, a terminal, a printer, a modem or any devices that can receive or transmit RS232 ASCII data.

Together with the EP 500 postprocessing system it is possible to receive and display data online. This makes it possible to monitor a remote system by means of a modem and the worldwide telephone network..

The messages transmitted and received on the serial communication port are referred to as "telegrams".

The following information applies to all telegrams:

- All output telegrams contain a two-character header indicating the telegram type, for example PR for Parameter Request telegrams.

- "," separates fields within a telegram.

- <CR> denotes carriage return and <LF> denotes line feed.

- Two consecutive carriage returns <CR><CR> are used as telegram terminator in output telegrams implying that <CR><LF> can be used freely inside the telegrams in order to obtain a nice printout when using a standard printer.

- All output telegrams contain a time tag in the second field: hour, minute, second, hundredth of a second, for example 10024310.

- A menu parameter is identified by including its path in the menu system in the appropriate field.

  For example:

  /DISPLAY MENU/Echogram Menu/TVG

  addresses the TVG type to be used for the echogram on the display.

The * character may be used as a wildcard in the input telegrams.
The path string above would then look like:
/DISP*/E*U/TV*

- Input telegrams use a single carriage return <CR> as telegram terminator.

- The input telegram interpreter is insensitive to upper/lower case letters.

There are three types of output telegrams:

- Asynchronous telegrams (triggered by uncorrelated external and internal events)

- Ping-based telegrams

- Log-based telegrams.

There are three types of input telegrams:

- Parameter request telegrams

- Parameter enter telegrams

- Comment string (annotation) telegrams.

1.2 OUTPUT TELEGRAMS

Serial port output telegrams may be in either ASCII or binary format. The binary format is identical to the disk telegram format except for a header (4 bytes) containing both the number of bytes in the telegram (2 bytes) and its checksum (2 bytes). The checksum is the arithmetic sum of all bytes in the telegram. This checksum is used by the receiving system to ensure good quality of data telegrams. Telegrams with a faulty cheksum should be disregarded.

The ASCII format should be selected when the need for reading the data as text is important. Binary is more compact, and is used for data transfer directly to computer or via modem (e.g. EP 500).

1.3 ASYNCHRONOUS OUTPUT TELEGRAMS

Examples of asynchronous output telegrams:

```
PR,10024310,/OPERATION MENU/Ping Mode=Normal<CR><CR><LF>          → parameter request
PE,10024720,/OPERATION MENU/Ping Interval=1.3 sec<CR><CR><LF>     → parameter enter
CS,10031140,TS measurements near Greenland<CR><CR><LF>           → comment string
                                                                    (annotation)
GL,10031520,4728.31,N,12254.25,W<CR><CR><LF>                     → navigation data
ST,10041140,Ping-interval warning<CR><CR><LF>                  → status telegram
```

PR is returned as a response to a parameter request input telegram and contains the header PR, the time tag, the path and the parameter.

PE reports that a parameter has been entered (due to a manual command operation from the menu), and contains header,time path, parameter.

CS reports that an annotation comment string has been entered (from the keyboard or as an input annotation telegram), and contains header, time tag, annotation string.

GL contains navigation data: header, time tag, position data substring.

ST reports errors, warnings and alarms: header, time tag, message string.

1.4 PING-BASED OUTPUT TELEGRAMS

Examples of ping-based output telegrams:

```
D1,10024330,74.42,-18,  1,-23<CR><CR><LF>                         → bottom depth
E1,10024330, 5,<CR><LF>                                           → echo trace
   32.40,-41.6,-43.2, -2.3,  3.4,<CR><LF>
   36.35,-29.2,-31.1,  4.1, -4.3,<CR><LF>
   37.75,-33.7,-34.1,  2.2,  2.2,<CR><LF>
   42.10,-45.2,-45.9, -1.2, -1.5,<CR><LF>
   61.10,-37.7,-38.6, -3.3,  2.4,<CR><CR><LF>
S1,10024330, 3,<CR><LF>                                           → ping based Sv
   1,-87.5,  30.00,<CR><LF>
   2,-56.3,  28.72,<CR><LF>
   9,-61.6,  20.00<CR><CR><LF>
```

```
                TVG   DEPTH   MAIN    MAIN    ECHO-   BOTTOM   BOTTOM BOTTOM   ECHO-
                 ↓      ↓     RANGE   RANGE   GRAM    RANGE    RANGE  ECHO-    GRAM
                             START   STOP    VALUES  START    STOP   GRAM     DATA
                               ↓       ↓       ↓       ↓        ↓    VALUES   (in dB)
                                                                      ↓        ↓
Q1,11360180,0,    29.65,     0.0,   100.0,250,    10.0,    -5.0, 75,
    -2.1,  -1.9, -48.5, -82.8, -87.7, -98.7, -99.1, -99.3, -98.9, -96.5,┐
   -95.9, -94.2, -91.9, -92.6, -95.0, -94.7, -84.3, -84.7, -83.3, -81.9,│
   -80.3, -87.8, -89.0, -75.1, -63.7, -65.1, -75.9, -79.4, -81.5, -77.9,│
   -76.6, -77.8, -79.9, -82.3, -82.2, -75.7, -75.3, -76.0, -76.3, -76.6,│
   -85.4, -83.6, -81.7, -80.1, -80.1, -81.1, -82.3, -81.6, -80.4, -81.3,│
   -82.7, -82.4, -82.0, -73.6, -71.7, -73.4, -73.5, -72.9, -75.2, -76.9,│
   -76.7, -75.5, -77.6, -80.3, -79.5, -78.9, -73.7, -71.8, -70.0, -70.5,│
   -72.0, -73.4, -71.1, -70.0, -38.6, -37.2, -37.1, -37.0, -36.8, -36.7,│
   -36.6, -36.5, -36.3, -36.2, -36.1, -36.0, -35.8, -35.7, -35.6, -35.5,│
   -35.4, -35.2, -35.1, -35.0, -34.9, -34.8, -34.7, -34.6, -34.5, -34.4,│
   -34.3, -34.2, -34.1, -34.0, -33.9, -39.2, -40.5, -37.3, -34.9, -40.2,│
   -42.2, -41.1, -39.9, -39.8, -40.3, -44.9, -44.9, -44.8, -46.9, -48.2,│
   -48.1, -52.3, -48.6, -50.9, -47.7, -50.0, -53.4, -53.4, -53.0, -47.4,│ Main
   -48.3, -52.8, -52.9, -54.2, -59.2, -53.4, -52.6, -52.6, -53.4, -53.9,│ echo-
   -52.3, -53.5, -52.2, -52.2, -51.9, -51.8, -53.0, -54.6, -52.3, -53.3,│ gram
   -51.4, -50.3, -45.5, -44.1, -41.8, -41.7, -37.4, -36.2, -40.5, -41.4,│ (250
   -41.3, -38.3, -35.8, -35.8, -30.0, -28.8, -29.2, -36.2, -38.3, -35.3,│ values)
   -30.3, -28.4, -32.7, -35.1, -40.0, -37.9, -34.9, -34.8, -34.7, -37.9,│
   -35.3, -34.6, -32.0, -29.2, -34.3, -34.2, -34.2, -34.2, -34.0, -34.6,│
   -39.3, -39.2, -39.1, -35.2, -37.3, -41.8, -47.1, -38.9, -38.8, -40.0,│
   -42.2, -42.1, -42.1, -38.9, -41.4, -39.1, -43.2, -48.8, -51.1, -48.2,│
   -47.3, -51.0, -64.0, -65.3, -68.6, -68.1, -59.1, -58.7, -57.6, -57.3,│
   -58.5, -61.2, -57.9, -59.1, -58.3, -57.7, -55.8, -62.6, -64.3, -65.9,│
   -66.0, -66.8, -64.6, -63.2, -63.4, -63.0, -61.0, -61.2, -63.9, -65.5,│
   -63.7, -55.1, -54.2, -54.7, -54.8, -55.4, -64.8, -63.2, -62.9, -60.4,┘
   -81.1, -83.2, -82.0, -83.0, -82.9, -82.4, -82.1, -80.3, -78.5, -70.6,┐
   -71.4, -72.4, -73.4, -73.2, -74.4, -73.4, -72.9, -72.7, -74.3, -78.2,│ Bottom
   -77.7, -76.2, -77.0, -75.5, -75.1, -76.3, -77.5, -79.6, -80.4, -79.6,│ echo-
   -79.7, -79.4, -78.4, -79.1, -74.5, -72.0, -72.4, -70.4, -70.0, -71.0,│ gram
   -70.3, -70.8, -71.7, -71.6, -73.3, -75.0, -70.6, -70.6, -70.0, -69.9,│ (75
   -38.8, -37.3, -37.2, -37.1, -37.1, -37.0, -37.0, -36.9, -36.9, -36.8,│ values)
   -36.8, -36.7, -36.6, -36.5, -36.5, -36.4, -36.3, -36.3, -36.2, -36.1,│
   -36.1, -36.0, -35.9, -35.9, -35.9,                                    │
                                                                         ┘
```

D1 contains the detected depth: header, time tag, depth [meter], bottom surface backscattering strength [dB], transducer number, dummy.

E1 contains single-echo detections for one ping: header, time tag, number of single echo detections, depth [meter], compensated TS [dB], uncompensated TS [dB], fore-and-aft angle [degrees], athwartships angle [degrees] etc. Note that max. 30 single-echo detections can be output.

S1 contains the mean S_v per ping inside each active main layer and the effective thickness of the layer: header, time tag, number of active layers, layer number, mean S_v [dB], effective thickness [meter] etc. Note that S_v values smaller than -99.9 dB causes $$$.$ to be printed.

Q1 contains main and bottom echogram values in dB as ASCII text. This long telegram should only be used for special studies since the capacity of the serial line is limited and overflows even at a moderate ping rate. The binary mode is a lot more efficient (See echogram Q1 in The Disk Storage chapter).

1.5 LOG-BASED OUTPUT TELEGRAMS

Examples of log-based output telegrams:

```
VL,10030740,930523,1834.015<CR><CR><LF>                          → vessel log
LL,10031120,930523,1835.000, 1, 3,<CR><LF>                       → layer settings
   1,S,  10.0,  40.0, 1.0, 1, -80.0,<CR><LF>
   2,S,  40.0,  70.0, 1.0, 1, -80.0,<CR><LF>
   9,B,  20.0,   0.0, 5.0, 1, -80.0<CR><CR><LF>
A1,10031120,930523,<CR><LF>                                      → integrator table
     31,<CR><LF>
    121,<CR><LF>
  27E-1<CR><CR><LF>
H1,10031120,930523,-50.0,<CR><LF>                                → TS distribution table
  818,38,38,17, 6, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,<CR><LF>
   73, 0, 0, 0, 0, 4, 4,11,16,14,10, 4,18,10, 3, 3, 3, 0, 1, 0, 0, 0, 0, 0, 0,<CR><LF>
   88, 0, 0, 0, 0, 3, 3, 9,16,11, 9, 5,18,12, 6, 2, 2, 1, 1, 0, 0, 0, 0, 0, 0<CR><CR><LF>
```

VL reports that a log pulse has been detected and contains header, time tag, date, updated log distance [nm].

LL is output every log interval and contains the current layer settings: header, time tag, date, current log distance [nm], super layer, number of active layers, layer number, layer type (S, B or P), upper depth [meter], lower depth [meter], margin distance [meter], the value 1, S_v threshold value [dB] etc.

A1 is output every log interval and contains the integration results within each layer: header, time tag, date, first active main layer [m^2/nm^2], second active main layer [m^2/nm^2] etc. Note that a special exponential format is used for representing very small and very large numbers.

H1 is output every log interval and contains the TS distribution within each layer: header, time tag, date, lower boundary of TS range [dB], total number of single echo detections within first active main layer, 24 fields containing detections within each TS class (percentage of relative total number of detections), total number of single echo detections within second active main layer etc.

1.6 INPUT TELEGRAMS

There are three different types of input telegrams:

```
/operation menu/ping mode<CR>                    → parameter request
/operation menu/ping interval=1.3<CR>            → parameter enter
CS, TS measurements in lake Borrevann<CR>        → comment string
                                                   (annotation)
```

A PR output telegram is returned by the echo sounder when a parameter request telegram is sent as input to the sounder. This telegram simply consists of the path of the parameter. A parameter is entered by specifying the path and the new parameter value, separated by a = sign. Input telegrams not starting with a / are taken as annotation input strings. It should be observed that:

- continuous variable parameter values are processed numerically and may be entered with or without dimension
- discrete parameter values are processed as strings and must be entered with dimension
- the wildcard character * matches any substring of characters within menu names, parameter names and discrete parameter value strings.
- there is no distinction between upper and lower case characters.
- the password of the utility menu can not be remotely controlled or requested.
- test menu parameters can not be remotely controlled or requested.

Some parameters include two or more numeric quantities, and these are remotely entered/requested as shown below:

```
/utility*/date=93.06.06<CR>      → year, month, day
/util*/time=14:41:16<CR>         → hour, minute, second
```

2 THE DISK STORAGE

2.1 GENERAL

The hard disk in the PC is an independent device with its own echogram definition. Several telegram types may be enabled for on-line storage. When LOG in the Disk Menu is ON, the data will automatically be given a name including creation time. The file will be terminated at the current file size given in MAX. FILE SIZE in the Disk Menu or by turning Disk Menu/Log = OFF. The postprocessing system will read these files and enable the user to scrutinize the data with new layer limits.

The SHOW program supplied with the Utility Disk enables the user to convert the binary telegrams stored in a file into an ASCII readable file for easy inspection of EY 500 data.

All relevant files are stored in the EY 500 directory.

File name:	**Contents:**
EY500.PAR	Backup parameters of all EY 500 settings. (Refer to chapter "The EY 500 file system" in section "Operation").
MoDaHoMi.DGY	Data files containing telegrams. EY 500 files will be automatically created when LOG in the Disk Menu is ON, or when the current file size limit is reached. The file name contains a unique identification with respect to month, day, hours, minutes and year. Example: 06061105.DG4.

06	06	11	05	.	DG	4
Month	Day	Hours	Minutes	.	DG	Year
2-digit identifier (1-12)	2-digit identifier (1-31)	2-digit identifier (1-23)	2-digit identifier (1-59)		EY 500 data-gram	1-digit identifier (1-9)

The disk storage facility implements all telegrams found on the Serial Communication port, but also includes four new telegrams:

- B1 sample angle data
- W1 sample power data
- V1 sample S_v data
- P1 sample TS data

The disk storage is basically the binary type of telegrams. The main changes made moving from ASCII to binary telegram format are:

- Numeric quantities are represented by the appropriate binary type, and text strings remain unchanged.
- Output telegrams do not include carriage returns or line feeds.
- All output telegrams start with a two character header and a time tag separated by a comma just as the ASCII version of the telegrams.
- All telegrams have a four-byte length field in front giving the number of bytes in the current telegram.

The telegrams are described in the next paragraphs using C programming language structures. The size of the various C types are:

- char 8-bit integer
- short 16-bit integer
- long 32-bit integer
- float 32-bit floating point IEEE 754

Structure members of type array are defined with their maximum size. During real data transfer their actual size depends on EY 500 parameter settings and data statistics. Many computers can only access two-byte quantities at even addresses and four-byte quantities at addresses dividable by four. A few telegrams therefore include a dummy fill parameter in order to facilitate communication with these computers. Note that binary quantities are transmitted in Intel byte order (least significant byte first).

2.2 ASYNCHRONOUS OUTPUT

```
struct Text {                   /* parameter request */
  char  Header[2];              /* "PR" */
  char  Separator1[1];          /* "," */
  char  Time[8];                /* hour, minute, second, hundredth */
  char  Separator2[1];          /* "," */
  char  Text[256];              /* parameter path and value */
};
```

```
struct Text {                   /* parameter enter */
  char  Header[2];              /* "PE" */
  char  Separator1[1];          /* "," */
  char  Time[8];                /* hour, minute, second, hundredth */
  char  Separator2[1];          /* "," */
  char  Text[256];              /* parameter path and value */
};


struct Text {                   /* comment string (annotation) */
  char  Header[2];              /* "CS" */
  char  Separator1[1];          /* "," */
  char  Time[8];                /* hour, minute, second, hundredth */
  char  Separator2[1];          /* "," */
  char  Text[256];              /* comment string */
};


struct Text {                   /* geographical location (navigation) */
  char  Header[2];              /* "GL" */
  char  Separator1[1];          /* "," */
  char  Time[8];                /* hour, minute, second, hundredth */
  char  Separator2[1];          /* "," */
  char  Text[256];              /* geographical position */
};


struct Text {                   /* status telegram */
  char  Header[2];              /* "ST" */
  char  Separator1[1];          /* "," */
  char  Time[8];                /* hour, minute, second, hundredth */
  char  Separator2[1];          /* "," */
  char  Text[265];              /* error, warning or alarm message */
};
```

2.3 PING BASED OUTPUT

```
struct Depth {                  /* detected bottom depth */
  char  Header[2];              /* "D1" */
  char  Separator1[1];          /* "," */
  char  Time[8];                /* hour, minute, second, hundredth */
  char  Separator2[1];          /* "," */
  float Depth;          /* detected bottom depth [meter] */
  float Ss;                     /* bottom surface backscattering strength [dB] */
  long Transducer Number;  /* transducer number */
  float Dummy2;                 /* not implemented in EY 500 */
};


struct EchoTrace {              /* echotrace (single fish detections) */
  char  Header[2];              /* "E1" */
  char  Separator1[1];          /* "," */
  char  Time[8];                /* hour, minute, second, hundredth */
  char  Separator2[1];          /* "," */
  long  Traces;                 /* number of echo traces in telegram */
  struct {
    float Depth;                /* target depth [meter] */
    float CompTS;               /* compensated TS [dB] */
    float UncompTS;             /* uncompensated TS [dB] */
    float AlongShip;            /* alongship angle [degree] */
    float AthwartShip;          /* athwartships angle [degree] */
  } Trace[30];                  /* max 30 detections per ping */
    float Sa[30];               /* Sa values for single targets */
};


struct MeanSv {                 /* Mean Sv per ping */
  char  Header[2];              /* "S1" */
  char  Separator1[1];          /* "," */
  char  Time[8];                /* hour, minute, second, hundredth */
  char  Separator2[1];          /* "," */
  long  Layers;                 /* number of active layers */
  struct {
    long  LayerID;              /* layer identifier [1-10] */
    float MeanSv;               /* mean Sv per ping within layer [dB] */
    float MeanWidth;  /* mean effective thickness of layer [meter] */
  } Layer[10];                  /* max 10 layers */
};
```

```
struct Echogram {              /* echogram (post processor) */
  char  Header[2];             /* "Q1" */
  char  Separator1[1];         /* "," */
  char  Time[8];               /* hour, minute, second, hundredth */
  char  Separator2[1];         /* "," */
  long  TVGType;               /* TVG type: */
  float Depth;          /* detected bottom depth [meter] */
  float PelagicUpper; /* upper depth of pelagic echogram [meter] */
  float PelagicLower; /* lower depth of pelagic echogram [meter] */
  long  PelagicCount;          /* number of pelagic echogram data points */
  float BottomUpper;           /* upper depth of bottom echogram [meter] */
  float BottomLower;           /* lower depth of bottom echogram [meter] */
  long  BottomCount;           /* number of bottom echogram data points */
  short Data[1200];            /* max 1200 pelagic+bottom echogram data points */
};
```

The resolution of the pelagic echogram and the bottom echogram is controlled by parameters in the Disk Menu. The TVG type indicates which TVG is used (0 = 20 log R, S_v, 1 = 40 log R, TS). Depth and range parameters are output in meter. The size of the pelagic echogram array and bottom echogram array are included. The S_v/TS data is output in the EY 500 dB format (Refer to section "Theory of Operation", chapter 3, "EY 500 dB format").

```
struct Sample {                /* sample angle data */
  char  Header[2];             /* "B1" */
  char  Separator1[1];         /* "," */
  char  Time[8];               /* hour, minute, second, hundredth */
  char  Separator2[1];         /* "," */
  short Data[5000];            /* max 5000 data points per data block*/
};
```

The B1 output telegram provides angle sample data from the transceiver (applies to split beam transducer channel only) and is used for special purpose studies. The fore-and-aft (alongship) and athwartships electrical angles are output as one 16-bit word; the alongship angle as the most significant byte and the athwartships angle as the least significant byte. Angle data is output in units of phase steps (64 phase steps = 180 electrical degrees) where the least significant seven bits are the magnitude and the most significant bit is the sign; zero in the fore and starboard direction, one in the aft and port direction. Thus, an angle is <u>not</u> expressed in 2's complement. The sample data limits are given by the sample range in the Disk Menu/Telegram Menu.

```
struct Sample {              /* sample power data */
  char  Header[2];           /* "W1" */
  char  Separator1[1];       /* "," */
  char  Time[8];             /* hour, minute, second, hundredth */
  char  Separator2[1];       /* "," */
  short Data[5000];          /* max 5000 data points per data block*/
 };
```

The W1 output telegram provides echo amplitude sample data from the transceiver; power level referred to the transducer terminals as measured by the transceiver. Data is output in the EY 500 dB format (Refer to section "Theory of Operation", chapter 3). See the sample angle telegram for general comments.

```
struct Sample {              /* sample Sv data */
  char  Header[2];           /* "V1" */
  char  Separator1[1];       /* "," */
  char  Time[8];             /* hour, minute, second, hundredth */
  char  Separator2[1];       /* "," */
  short Data[5000];          /* max 5000 data points per data block */
};
```

The V1 output telegram provides volume backscattering strength sample data; power sample data with 20-log-r TVG added (Refer to section "Theory of Operation", chapter 2, "Power budget"). Data is output in the EY 500 dB format (Refer to section "Theory of Operation", chapter 3, "EY 500 dB format"). See the sample angle telegram for general comments.

```
struct Sample {              /* sample TS data */
  char  Header[2];           /* "P1" */
  char  Separator1[1];       /* "," */
  char  Time[8];             /* hour, minute, second, hundredth */
  char  Separator2[1];       /* "," */
  short Data[5000];          /* max 5000 data points per data block */
};
```

The P1 output telegram provides target strength sample data; power sample data with 40-log-r TVG added.. Data is output in the EY 500 dB format See the sample angle telegram for general comments. Also refer to section "Theory of Operation", chapter 3, "EY 500 dB format".

2.4 LOG BASED OUTPUT

```
struct VesselLog {              /* vessel log */
  char  Header[2];              /* "VL" */
  char  Separator1[1];          /* "," */
  char  Time[8];                /* hour, minute, second, hundredth */
  char  Separator2[1];          /* "," */
  char  Date[6];                /* year, month, day */
  char  Separator3[2];          /* ", " */
  float Distance;               /* vessel log distance [nautical mile] */
};


struct LayerSetting {           /* layer settings */
  char  Header[2];              /* "LL" */
  char  Separator1[1];          /* "," */
  char  Time[8];                /* hour, minute, second, hundredth */
  char  Separator2[1];          /* "," */
  char  Date[6];                /* year, month, day */
  char  Separator3[2];          /* ", " */
  float Distance;               /* vessel log distance [nautical mile] */
  short SuperLayer;             /* super layer identifier [1-10] */
  short Layers;                 /* number of active layers */
  struct {
    short LayerID;              /* layer identifier [1-10] */
    short Type;                 /* 'S' = surface, 'P' = pelagic, 'B' = bottom */
    float Upper;                /* upper layer boundary [meter] */
    float Lower;                /* lower layer boundary [meter] */
    float Margin;               /* margin distance [meter] */
    long  SubLayers;            /* always equal to 1 */
    float Threshold;            /* Sv threshold value [dB] */
  } Layer[10];                  /* max 10 layers */
};


struct TableSA {                /* Integrator output table */
  char  Header[2];              /* "A1" */
  char  Separator1[1];          /* "," */
  char  Time[8];                /* hour, minute, second, hundredth */
  char  Separator2[1];          /* "," */
  char  Date[6];                /* year, month, day */
  char  Separator3[2];          /* ", " */
  float SA[10];                 /* integrator values for active layer */
};
```

```
struct TableTS {              /* TS distribution table */
  char  Header[2];            /* "H1" */
  char  Separator1[1];        /* "," */
  char  Time[8];              /* hour, minute, second, hundredth */
  char  Separator2[1];        /* "," */
  char  Date[6];              /* year, month, day */
  char  Separator3[2];        /* ", " */
  float MinTS;                /* lower boundary of TS range [dB] */
  struct {
    long  Detections;         /* number of detections within layer */
    char  Class[24];          /* detections per TS class [%] */
  } Layer[10];                /* max 10 layers */
};
```

MAINTENANCE

P3405E / 857-160022 / 4AA062

This section contains information on preventive and corrective maintenance on the Simrad 500 Series portable echo sounders EY 500 and EA 501P.

Document revisions

Rev	Documentation department		Hardware/Software Design		Project/Product Management	
	Date	Sign	Date	Sign	Date	Sign
A	25.08.95	CL	25.08.95	HS	31.08.95	RB
B	15.03.96	CL	18.03.96	OC.	18.03.96	E.F

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Document history

(The information on this page is for Simrad's internal use)

Rev.A Original issue.

Rev.B The document is expanded to cover the portable echo sounders in the Simrad 500 Series; EA 501P and EY 500.

1 INTRODUCTION

This section is intended for the service engineer, and contains technical descriptions and service instructions down to a level of detail which is recommended by Simrad. Simrad's philosophy of service is that in most cases, the service engineer - with use of the information given here - should be able to locate and change a faulty circuit board or module, but will not do the repair on the circuit board level. The technical descriptions are based on block diagrams, and complete electronic diagrams are not included.

The echo sounder comprises the following units:

* Transceiver
* PC
* Transducer
* Printer
* DC power supply

For more details and technical specifications, refer to section "System Familiarization".

For details about the printer and the PC, refer to their respective manuals.

Figure 1 Transceiver with PC.

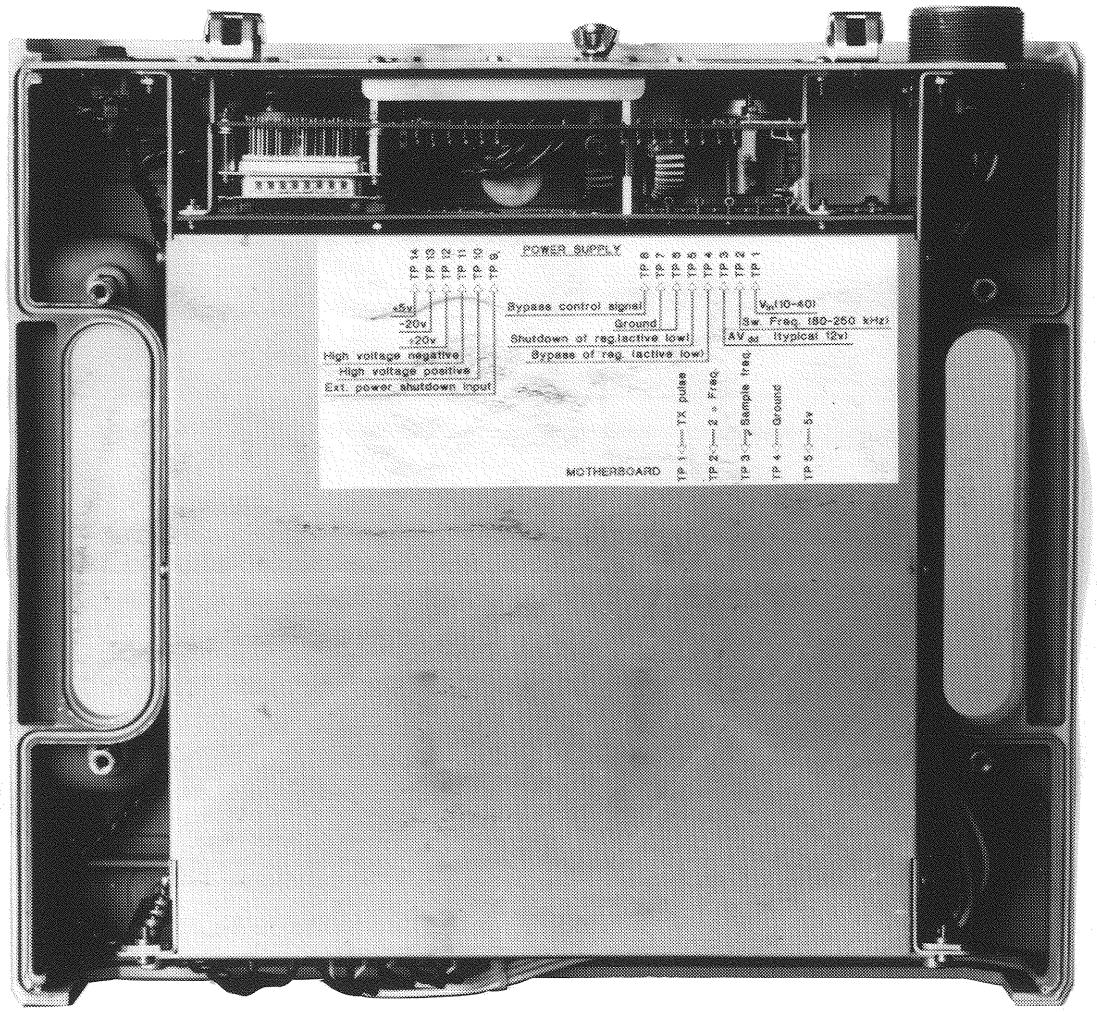


Figure 2 Inside view of the transceiver.

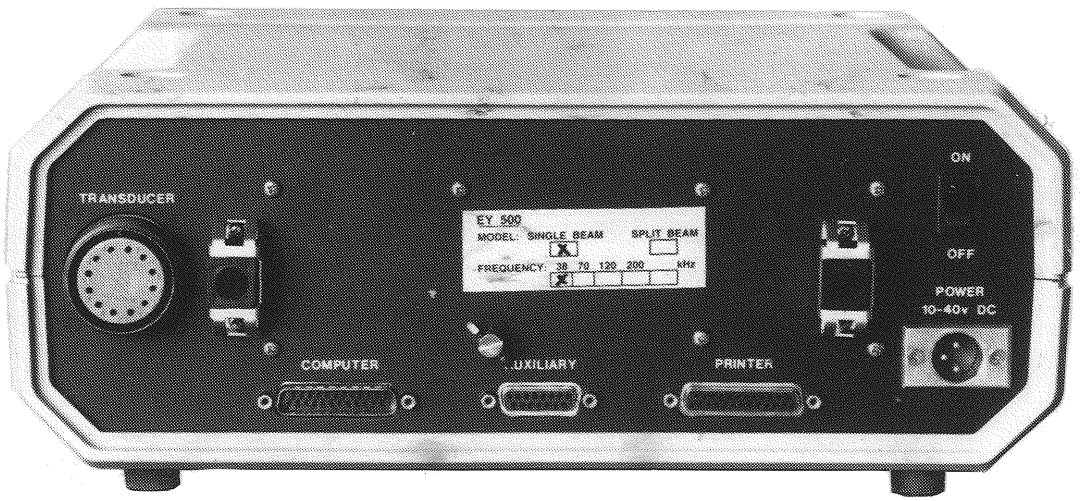


Figure 3 Rear interconnection panel.

2 TECHNICAL DESCRIPTION

2.1 INTRODUCTION

The transceiver unit contains the following printed circuit boards/modules:

* PC Interface board
* Digital transceiver board
* Analog transceiver board, single beam or split beam
* Backplane
* Power module

Figure 4 shows a simplified block diagram of the transceiver.

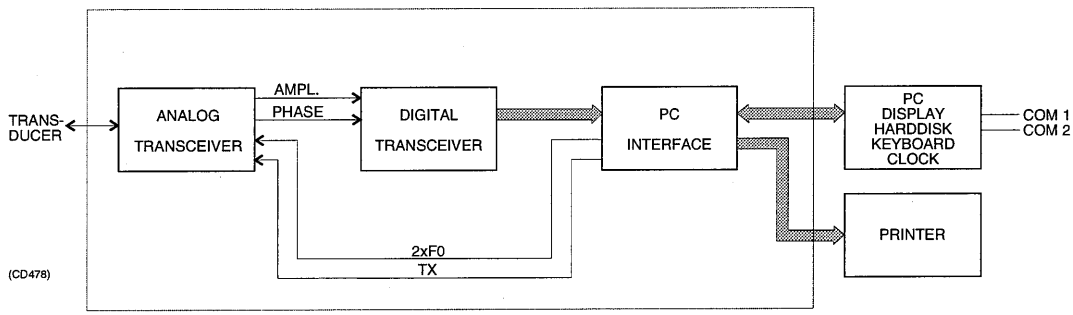


Figure 4 Transceiver block diagram.

* The analog transceiver/digital transceiver combination contains transmitter, receiver and A/D-conversion circuitry. The receiver does not contain any TVG (Time Varying Gain) function as the echo sounder implements this function solely in software. Instead, the receiving system is designed as a "power meter" with a large instantaneous dynamic range. Input power levels from -160 dBW to 0 dBW (dB's relative 1 W) are measured to a precision of a fraction of a dB and are output to the PC interface board as 16-bit digital words using the dBW scale for numeric representation. The receiver includes one receiving channel for single beam operation. For split-beam operation the receiver includes four matched channels plus phase measurement circuitry.

* The PC interface board includes Centronics printer interface and computer interface. It uses the standard parallel interface on the PC for reading data and controlling the transceiver and printer units.

For a complete interconnection diagram, refer to drawing 824-111019 in section "Drawings".

2.2 PC INTERFACE BOARD

Functional description

Refer to block diagram, Figure 5 and drawing 824-109291 (in section "Drawings"). The PC Interface board contains circuitry to provide an interface between the transceiver boards and the PC and printer. The board has 4 plugs:

P1, P2: Different input/output signals connected directly to the motherboard

P3: Printer

P4: Computer

Transducer Coding port
4 pins on the analog transceiver board are coded for frequency. The frequency information is routed through the PC interface card.

Demultiplexer
Converts amplitude and phase data to proper (4-bit) format for PC read control through MUX1 and MUX2.

Timer
Sets correct pulse length, frequency and sample clock.

Control outputs
Bandwidth, reset of transceiver FIFOs, test mode, TX-pulse trigger and beam type.

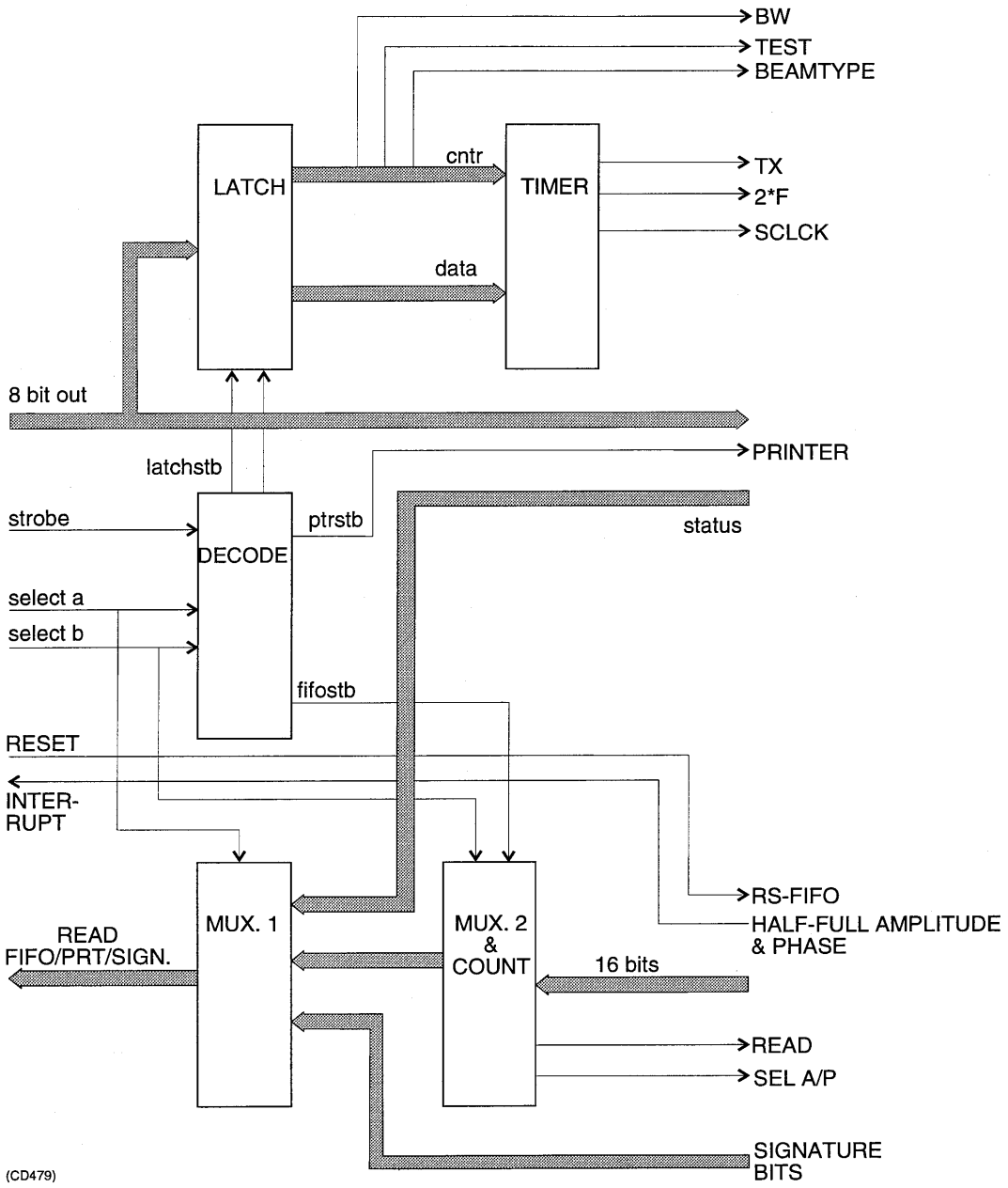


Figure 5 PC interface board, block diagram.

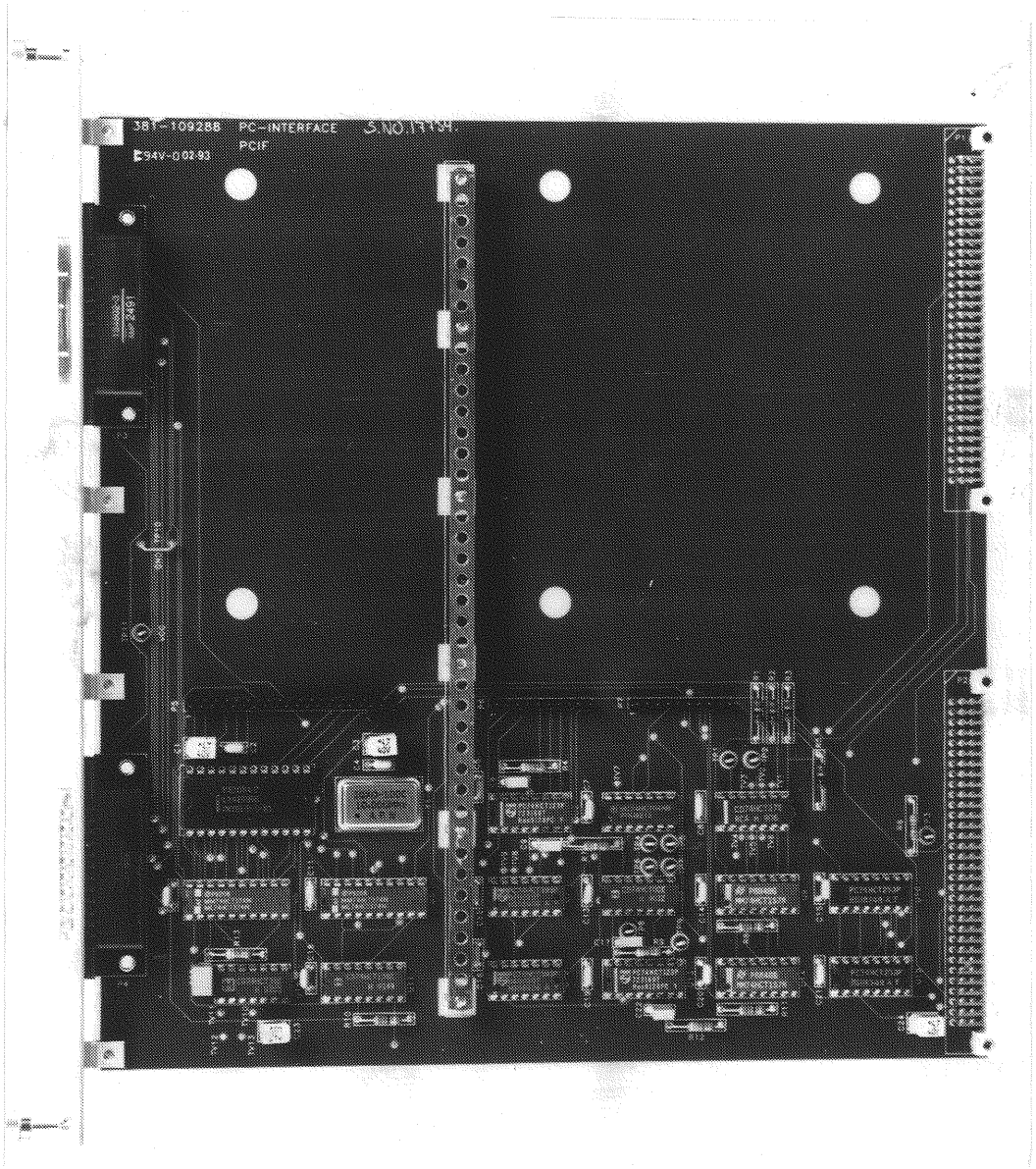


Figure 6 PC interface board.

Maintenance aids

There are two rows of test points on the board, P5 and P7.

P5

Check point	Information
1	A1. Timer control.
2	A0. Timer control.
3	CS/WR Timer control
4	TX trigger (active high)
5	Spare
6	Test (test = high)
7	Single/split (single = low)
8	BW (wide = low)
9-12	+5V
13-16	GND
17	2xfrequency
18	TX pulse
19	Sample clock

P7

Check point	Information
1-4	Not used
5	FIFO half full signal
6	FIFO reset (active = low)
7-10	Signature transducer bits (4)

2.3 DIGITAL TRANSCEIVER BOARD

Functional description

Refer to Figure 7.

This PCB is used between the analog transceiver board and the PC interface board. It converts amplitude and phase to digital words. It includes also an EPROM which converts the amplitude to a suitable format, and also FIFOs as a buffer memory.

Amplitude part:
The DC-amplitude from the receiver has 4 gain levels with 30-dB steps. These signals are routed to an A/D converter, one for each level. The A/D converter which has an amplitude within a specified value is selected and routed through a PROM. This PROM converts the amplitude to a format suitable for micro-processing. The microprocessor can select between up to 4 different formats. The 16-bit word out of the PROM is then stored in two FIFOs.

The four DC signals from the receiver envelope detectors have different amplitude levels with 30 dB steps, G1, G2, G3 and G4.

STEP	GAIN (dB)	Active amplitude region
G1	0	5V - 158mV
G2	30	5V - 158mV
G3	60	5V - 158mV
G4	90	5V - noise level

For each new ping there is first one reset pulse (RS/) to reset the FIFOs. Then the sample clock (SMPL/) starts a sequencer which then starts the four A/D converters simultaneously. The link B decides the A/D converter's clock frequency.

Phase part:
The TTL signals from the receiver containing phase information are routed through an XOR gate and into a counter network for phase-angle measuring. The phase angles and sign bits are represented in two 8-bit bytes. These bytes are then stored in two FIFOs. The values of the phase angles are measured in a digital hardware system of synchronous ICs. This makes it possible to get a fast and continuously updated phase angle value for each fourth zero-crossing of the signal (i.e. for each 760 degrees).

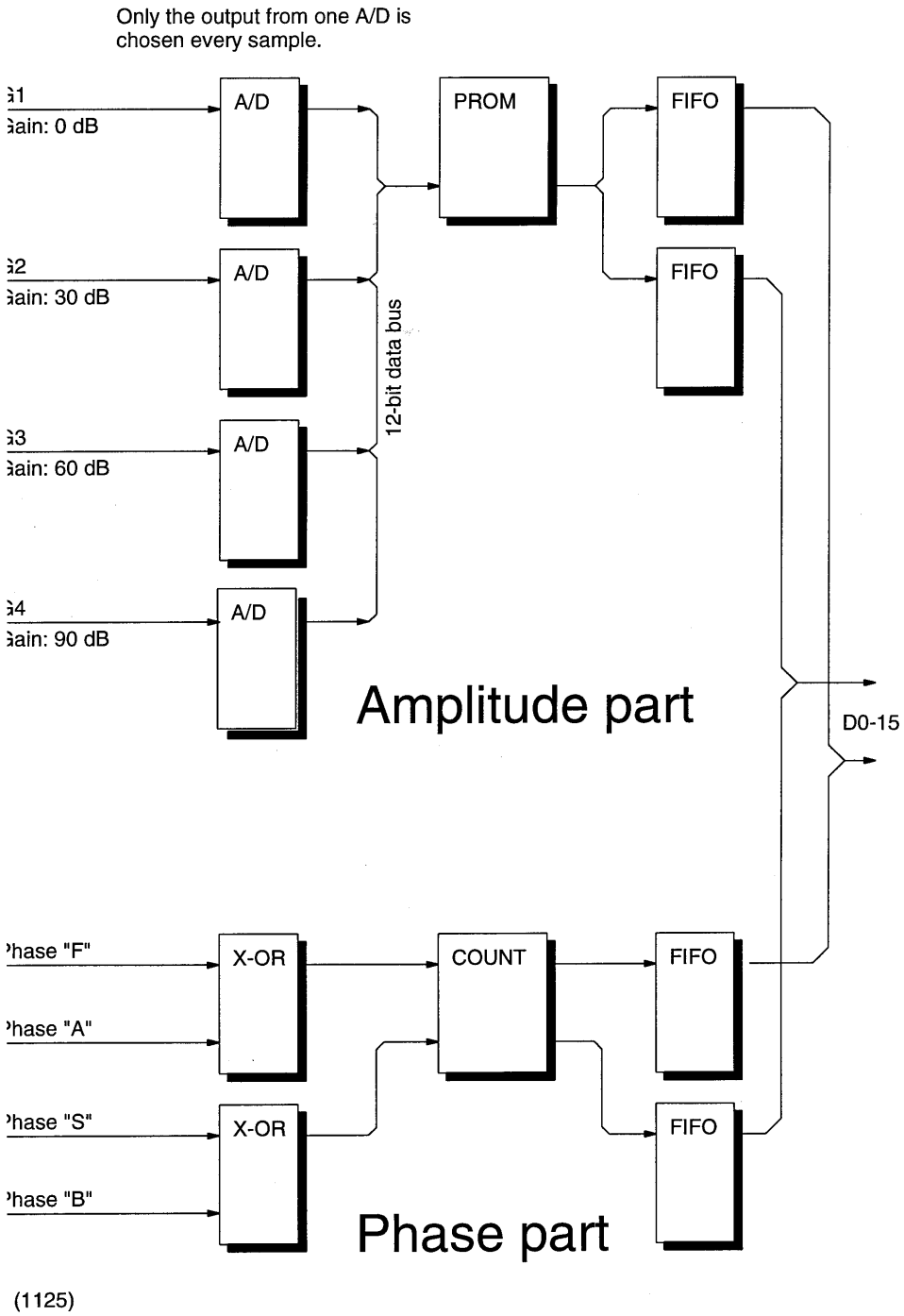


Figure 7 Digital transceiver board, block diagram.

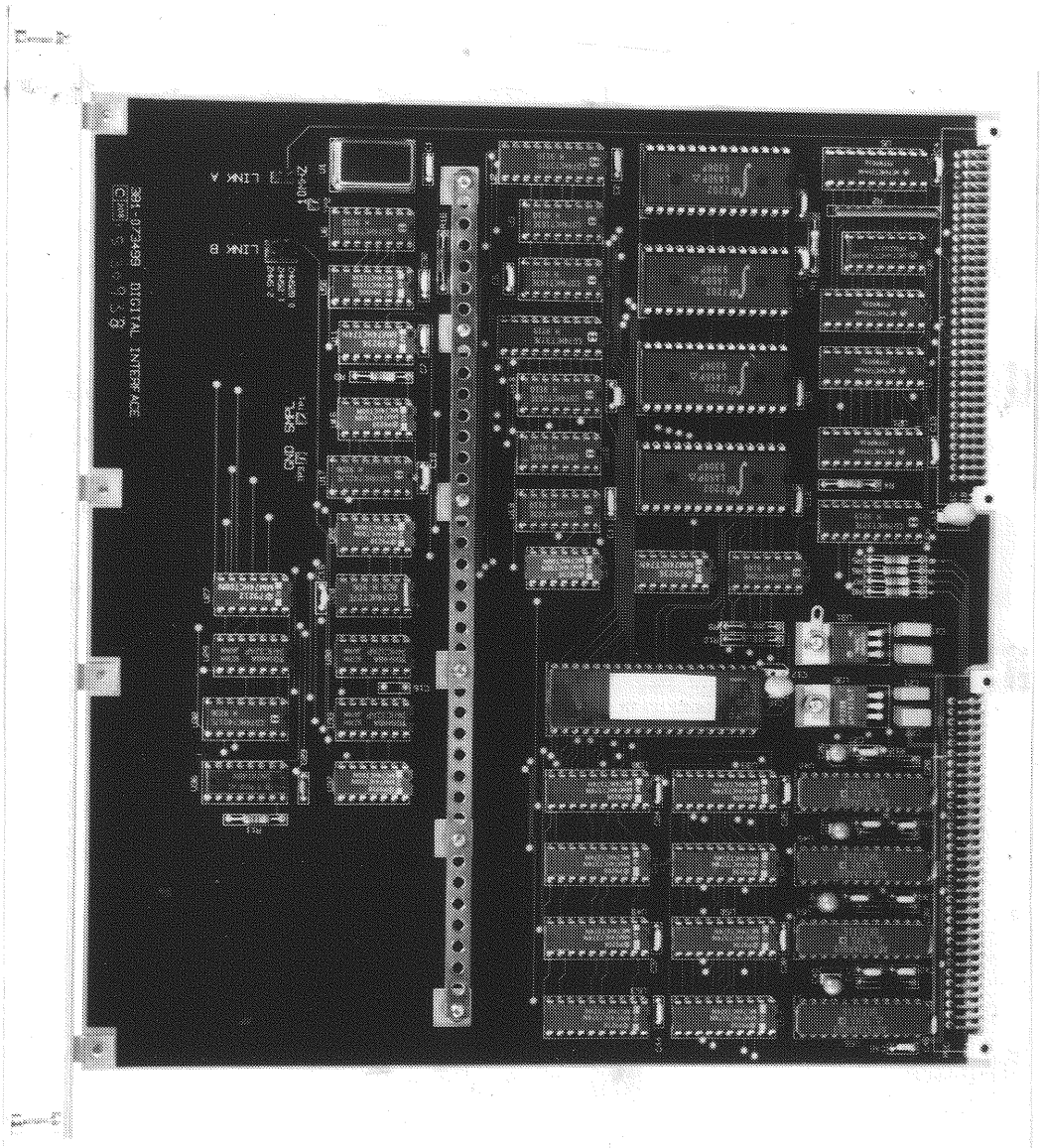


Figure 8 Digital transceiver board.

Maintenance aids

Test points

There are three internal test points.

Check point	Information
TP1	SMPL/ (inverted)
TP2	10 Mhz
TP3	GND

Links

A	10 MHz	Open
B	0.625 MHz	Open
	1.25 MHz	Mounted
	2.5 MHz	Open

EPROM

U34.

2.4 ANALOG TRANSCEIVER BOARD

Functional description

The analog transceiver board, split beam, contains a four-channel transmitter and a four-channel receiver. The transducer is connected to the board through plug P3. The board operates together with the digital transceiver board which digitizes amplitude and phase data to a format suitable for microprocessing. The single-beam version of this board is identical to the split-beam version, except that it only contains a one-channel transmitter and receiver, and has no outputs for phase information.

Transmitter
Refer to the lower part of Figure 9. The transmitter is controlled by two TTL-signals, the trigger signal TX/ and the signal 2xfo which decides the transmitter frequency fo. Both signals are generated on the PC interface board, and are dependent on transmitter frequency and menu settings. The transmitter has one transformer with four outputs. While receiving, the four channels are separated by anti-parallelled diodes. The transmitter has built-in short-circuit protection and has also a fuse in front for battery short-circuit protection

The TX-pulse is indicated by the LED across the transformer primary (located for easy viewing on the front of the board). The transmitter power can be halved by mounting link A instead of link B on the transformer primary side. There are four separate output channels.

Receiver
Refer to the upper part of Figure 9. The receiver has four separate receiver inputs, one from each of the transducer elements. It has a TR-switch which protects the receiver while transmitting, and it can take an amplitude of 5 volts RMS before it saturates. The gain over the input filter is about 16 dB and another 14 dB comes in the following transistor network.The next amplifier stage is a low-noise op amp and gives about 30 dB gain. The next amplifier stage gives also about 30 dB gain and it includes a low-Q bandpass filter as well.

At the end of each channel there is a precision comparator with a TTL-output which goes to the phase detector at the digital transceiver board. The input of the comparator is saturation protected with a voltage divider. The supply voltage to the comparators comes from separate voltage regulators because of noise considerations.

The four TTL outputs represent relative phase angles.

There are four analog outputs from the receiver with different grades of amplification. These outputs which represent the amplitude, have an active area from 158mV to 5V DC except the 90 dB gain output which operates from 5V down to the receiver's noise level.

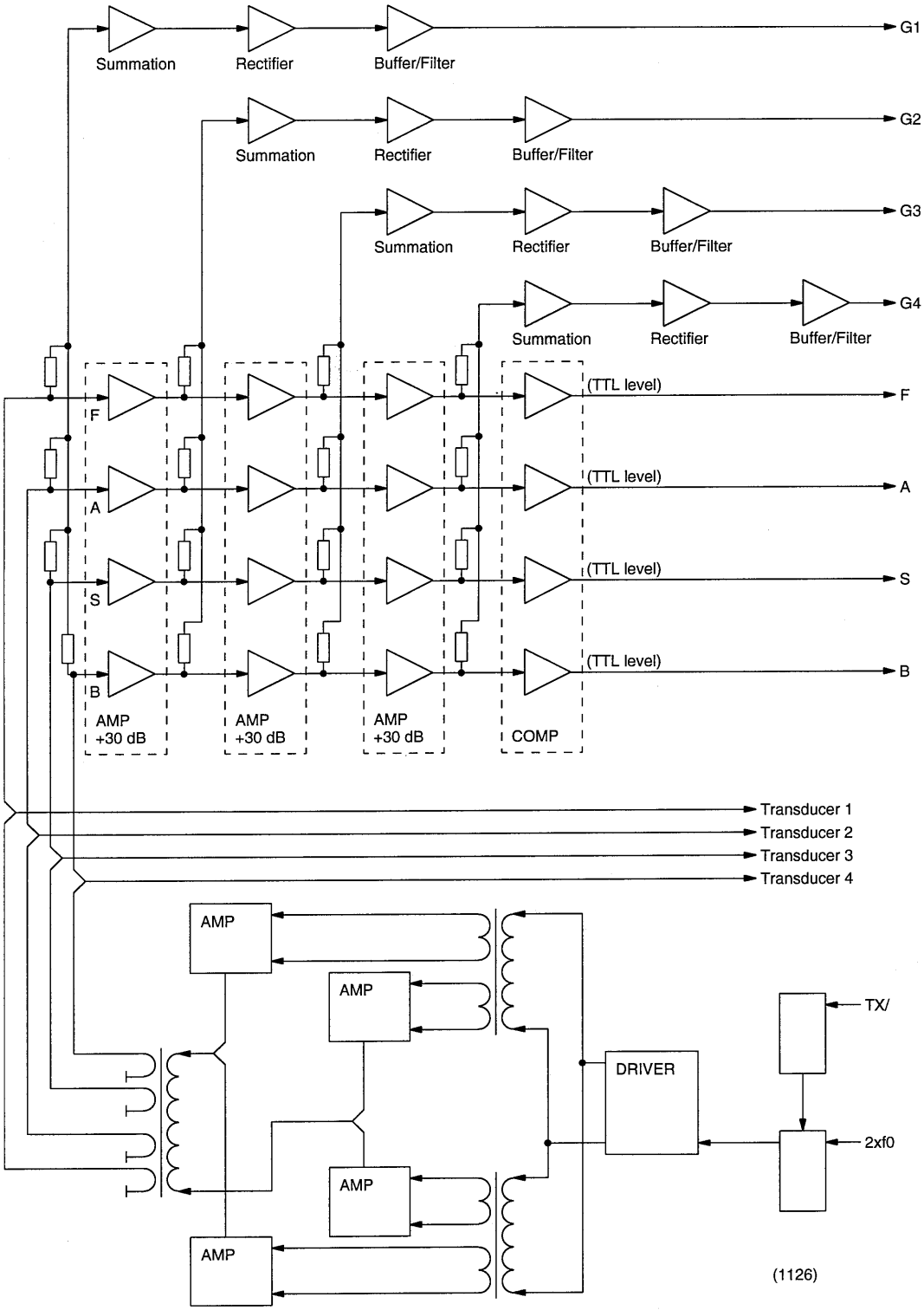


Figure 9 Transceiver, block diagram.

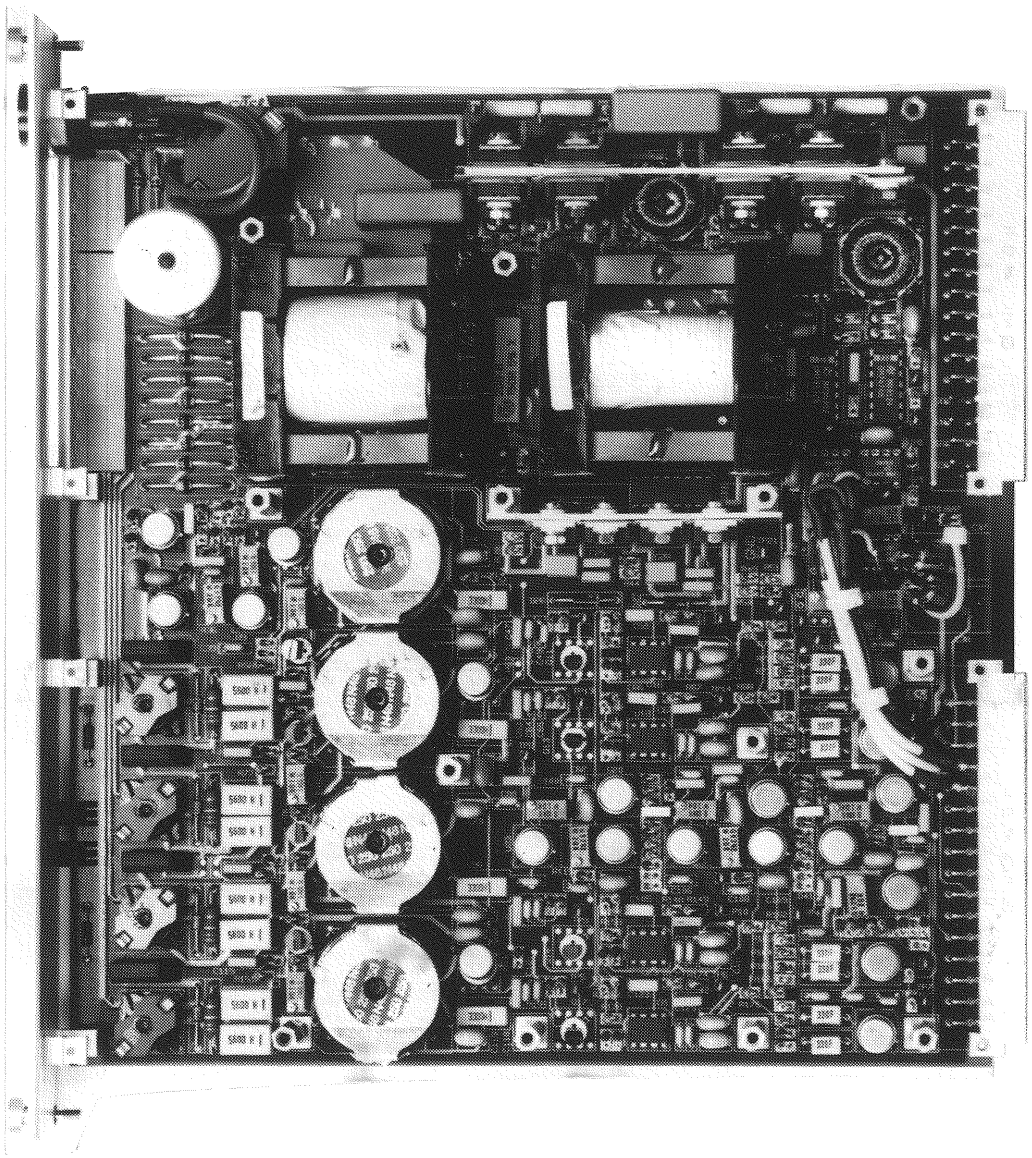


Figure 10 Analog transceiver board.

Maintenance aids

LEDs

In the front there are three LEDs. Two for internally regulated voltages ±15V to the receiver and one for the TX-pulse. The one for TX-pulse illuminates only at long TX-pulse. The TX-pulse is audible, but if there is much noise, this LED is useful to establish if there is a TX pulse present.

Test points

Internally the PCB contains a large number of test points. There is one after the 30 dB gain steps for each channel, one after summation of four channels and one for each phase output.

There is also one for GND. The analog outputs after the envelope detectors can be reached on P2.

Important test points:

TP22: 2xfo (2 x transmitter frequency)
TP23: TX/ (trigger pulse)

Links

B1: Max power
A1: 1/2 power

Transceiver board coding

Pins S3, S2, S1 and S0 on plug P1 are coded for transceiver frequency.

Coding				Clock frequency (MHz)	Transceiver type
S3	S2	S1	S0		
0	0	0	0	1.10	210 kHz single
0	0	0	1	1.25	12 kHz split
0	0	1	0	1.25	18 kHz single
0	0	1	1	1.25	18 kHz split
0	1	0	0	2.5	27 kHz single
0	1	0	1	2.5	27 kHz split
0	1	1	0	2.5	38 kHz single
0	1	1	1	2.5	38 kHz split
1	0	0	0	5	49 kHz single
1	0	0	1	5	49 kHz split
1	0	1	0	5	70 kHz single
1	0	1	1	5	70 kHz split
1	1	0	0	10	120 kHz single
1	1	0	1	10	120 kHz split
1	1	1	0	10	200 kHz single
1	1	1	1	10	710 kHz single

2.5 DC POWER SUPPLY

Refer to drawing 824-109632 in section "Drawings". The power supply contains a switching power supply generating the following DC voltages: +5V, ±20V and the high voltage (HV) for the transmitter (48V).

The supply can operate from an input voltage between 10V and 40V. The switching frequency can be between 80 and 250 kHz and may be adjusted within this range by potmeter R1. This makes it possible to reduce noise problems for the receivers by tuning the switching frequency away from the frequency of the receiver. All of the outputs can be short-circuited or left open without damaging the power supply, although input fuse F1 may blow.

Connections

Plug P1 is connected to the backplane.
Plug P2 is connected to the DC power source.
Plug P3 is connected to the high voltage.

LED

LED indicator: +5V OK.

Test points

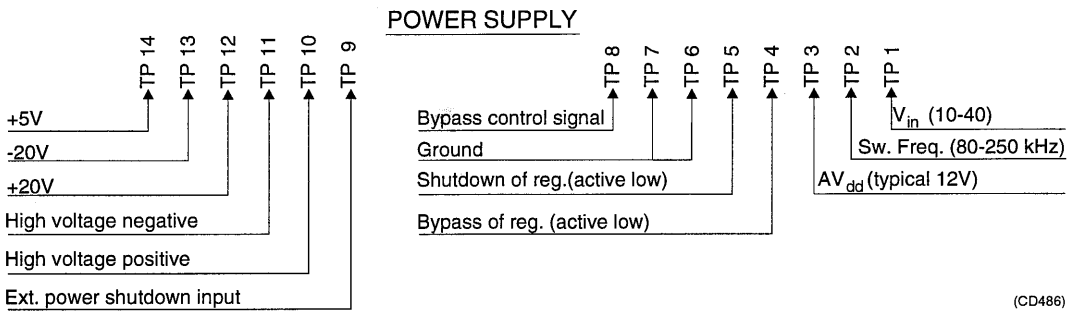


Figure 11 Test points on the DC power supply.

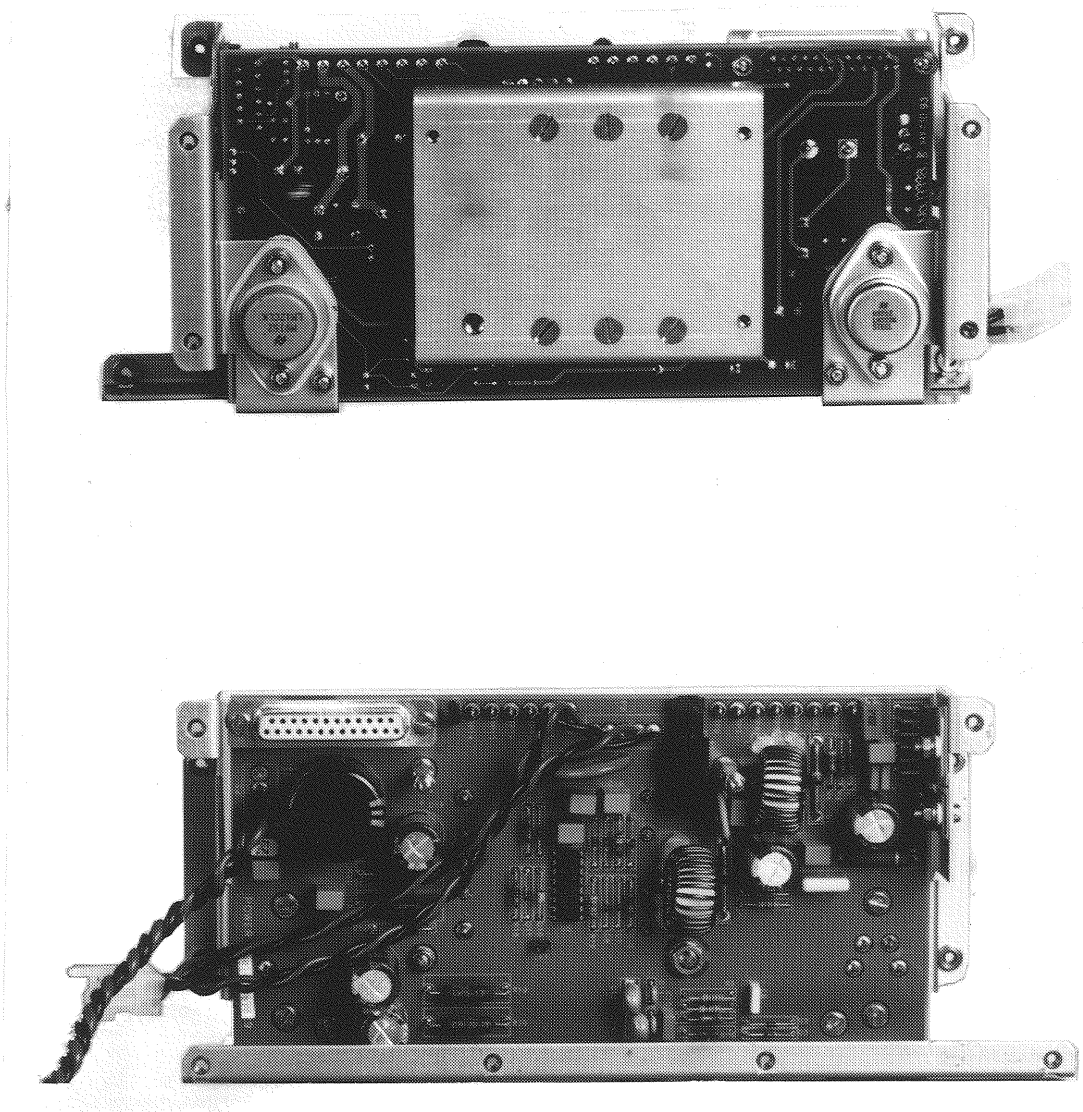


Figure 12 DC power supply.

2.6 BACKPLANE

Refer to drawing 824-109327 in section "Drawings".

Maintenance aids

Important test points:

TP1: TX pulse
TP2: 2xfo
TP3: SMPL frequency
TP4: GND
TP5: +5V

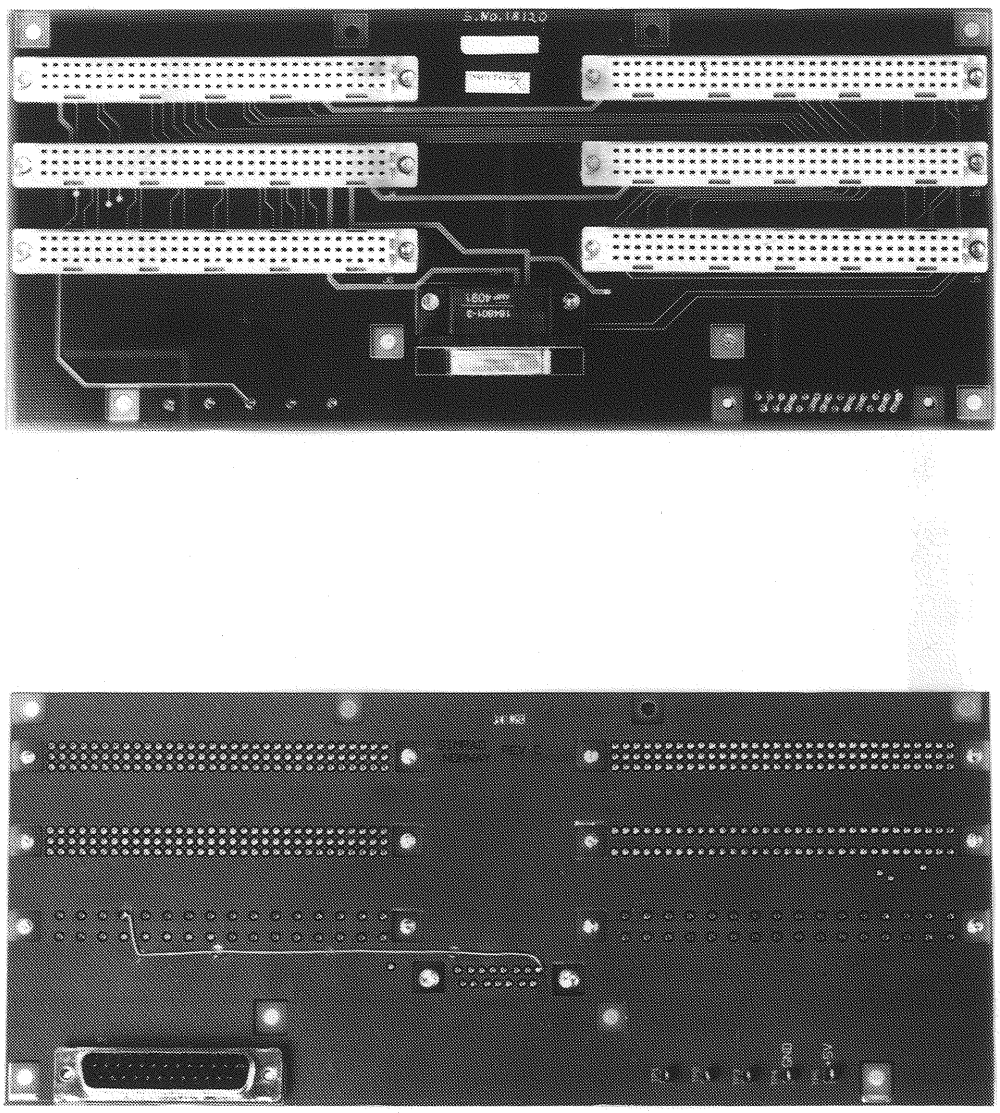


Figure 13 Backplane.

3 PREVENTIVE MAINTENANCE

The preventive maintenance on the echo sounder is very limited. When required, clean the surfaces of the equipment with a soft, lintfree cloth and a mild detergent.

For information about preventive maintenance on the computer and optional printer, refer to their respective instruction manual.

4 CORRECTIVE MAINTENANCE

4.1 FUSES AND TEST POINTS

There are two fuses in the transceiver unit, a 10 A fuse on the power supply and a 4A fuse on the analog transceiver board. A label on the cover for the PCB modules points to the test points on the DC power supply. For information about other test points, refer to the PCB descriptions.

4.2 TROUBLESHOOTING HINTS

CAUTION

To avoid electric shock, always switch off the mains voltage to the transceiver unit before removing printed circuit boards/components.

1. Check control settings.
   Incorrect control settings can indicate a trouble that does not exist. If there is any question about the correct function or operation of any of the menu commands, refer to section "Operation".

2. Check external equipment.
   Before proceeding with troubleshooting, check that equipment used with the echo sounder system is operating correctly. Also check that input/-output signals are properly connected and that the interconnecting cables are not defective. Check the supply voltage.

3. Visual check.
   Check the equipment visually. Many troubles can be found by visible indications, such as unsoldered connections, broken wires, damaged circuit boards or damaged components.

4. Check power supply.
   Incorrect operation of all circuits often indicates troubles in the power supply. Refer to the power supply description in this manual. +5V voltage is indicated by a LED on the top of the DC power supply, where also test points for the different voltages are located.

5. Built-in test functions.
   The built-in test functions of the echo sounder are described in paragraph 4.3.

4.3 BUILT-IN TEST FUNCTIONS

4.3.1 Internal test

Switch on the echo sounder.

Select the Operation Menu and set *Ping Mode* to *Off.*

Enter Test Menu/*Version*

The version number of software is displayed and should be the same as the version marked on the installation diskette.

Transceiver test

Select the Operation Menu and set *Ping Mode* to *Normal*
Select the Transceiver Menu
Set *Mode* to *Test*
Select the Test Menu
Activate *Transceiver*

Provided the transducer output has a 60-ohm termination, the following data will be displayed.

	AMPL:	ALO:	ATH:	NOISE:
SPL transducer	-55±2dB	0±2	0±2	-55±2dB
Single transducer:	-61±2dB	-	-	-61±2dB

4.3.2 Self-test procedure for printer

Switch off the printer
Disconnect the printer from the transceiver unit.
Start self-test: Press the FF knob while switching on printer.

The printer will print one page. Refer to printer user's guide.

Note that this is an internal test of the printer only. Interface ports are not tested, and therefore errors in communication between printer and transceiver unit will not be detected.

4.4 FAULT-FINDING PROCEDURE

CAUTION

To avoid electric shock, always switch off the mains voltage to the transceiver unit before removing printed circuit boards/components.

SYMPTOM	CHECK	REMEDY/FAULT
1. No transmitter pulse, no echo-gram.	Check fuse on front of transceiver board. If fuse not OK: If fuse blows again: Disconnect HV cable and measure resistance on P4, pins 1-4 (3-4 Mohms). If short circuit: If fuse OK: Check ±20V and +48V on DC power supply. Measure voltages in test points. TP14: +5V TP13: -20V TP12: +20V TP10→TP11: +48V	Change fuse. Faulty analog transceiver board.
	If not OK: If fuse/LED/voltages OK: Measure on HV cable on front of transceiver board (48V) If voltage OK:	Faulty DC power supply. Check cable. Faulty analog transceiver board.

SYMPTOM	CHECK	REMEDY/FAULT
2. System OK, display OK, transmitter pulse OK, but no echogram.	Set Mode in Transceiver Menu to Test. Enter Test Menu - Transceiver. Amplitude should be approx. -55 dB (split beam) or approx. -61 dB (single beam). Set Range to 50 m. The display should now show a striped colour pattern. (the pattern is frequency dependent). If not OK: If OK: Check transducer connection and measure transducer impedance (60 ohms).	 Faulty analog transceiver board/digital transceiver board.
3. No reaction after activating narrow/wide bandwidth from transceiver menu.		Faulty analog transceiver board or PC interface board.
4. No reaction after activating transceiver test signal from test menu.		Faulty analog transceiver board.
5. Wrong transceiver frequency displayed in transceiver menu.		PC parallel port not compatible. Backplane problem or faulty PC interface board.
6. Printer writes black/white when the system is switched on.	Switch printer on/off. If not OK: Check colour/black cartridge. If cartridge not OK:	 Change cartridge.

SYMPTOM	CHECK	REMEDY/FAULT
7. Printer writes random characters.	Run printer self test. If not OK: If OK: Measure cable. If cable OK:	 Printer defective. Faulty PC interface board or printer. Refer to Printer User Guide
8. Printer prints wrong colours or parts of characters are missing.	If wrong colours: Check colour cartridge. (Refer to Printer User Guide). If cartridge not OK: If black/white not OK: Check black cartridge. If not OK:	 Replace cartridge. Replace cartridge.
9. Error message: Printer not ready.	Check and measure cabling and plugs. If OK, change printer port. If error message disappears: If error message still on:	 Change PC interface board. Faulty PC interface board or printer.

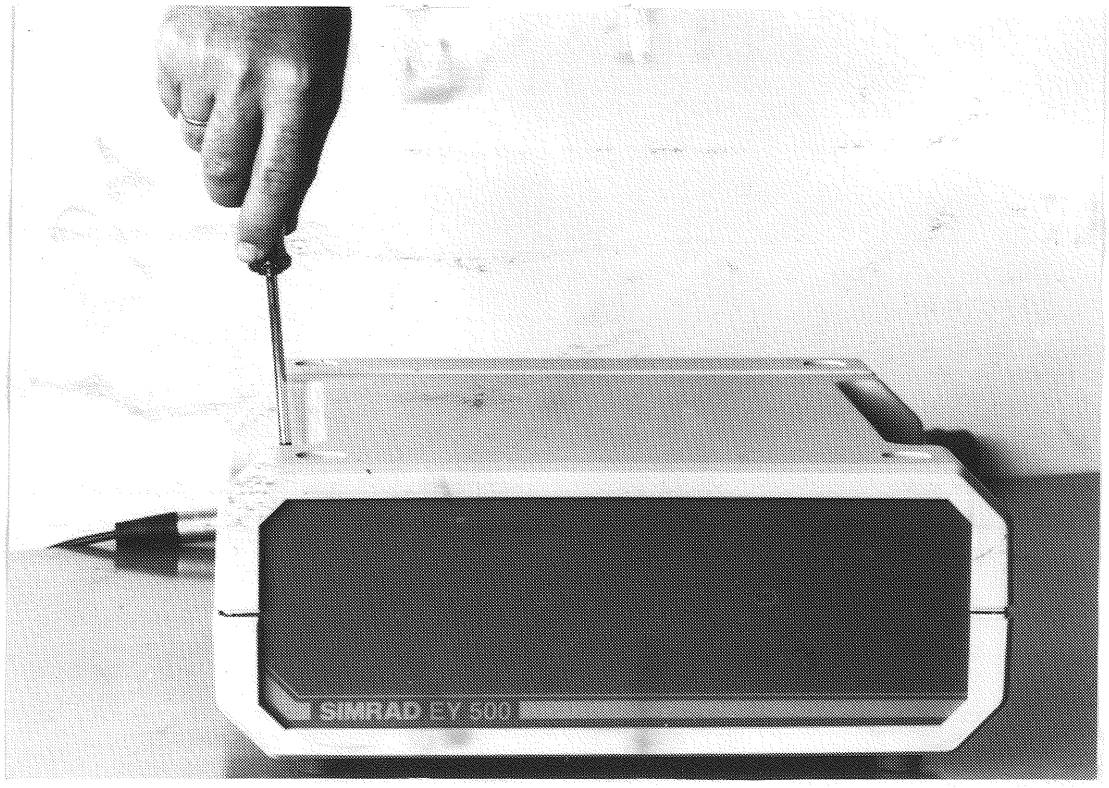
5 DISASSEMBLY/REASSEMBLY

5.1 INTRODUCTION

Only disassembly is described, for reassembly carry out the procedures in reverse order.

5.2 REMOVING THE UPPER COVER

Simply remove the four crosshead screw and lift up the cover.

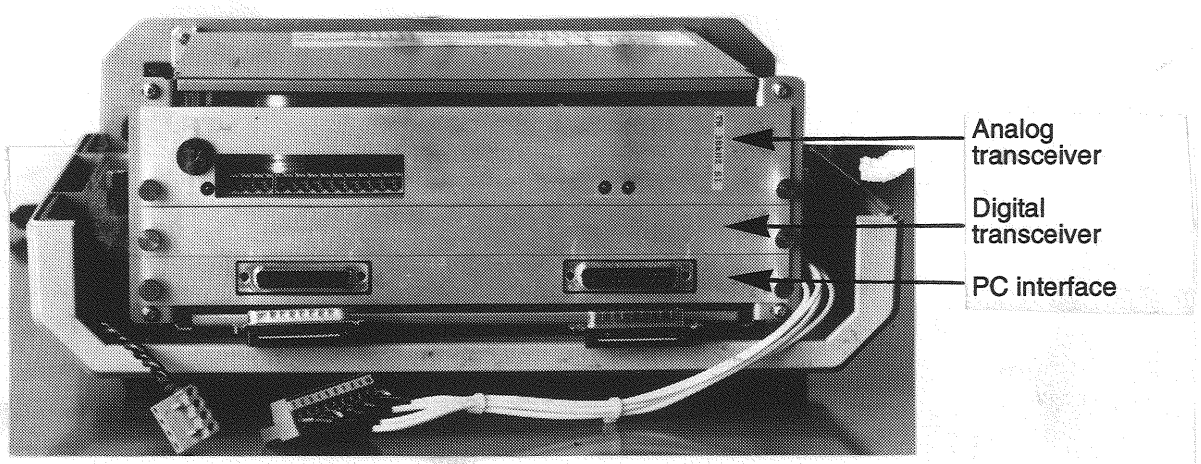


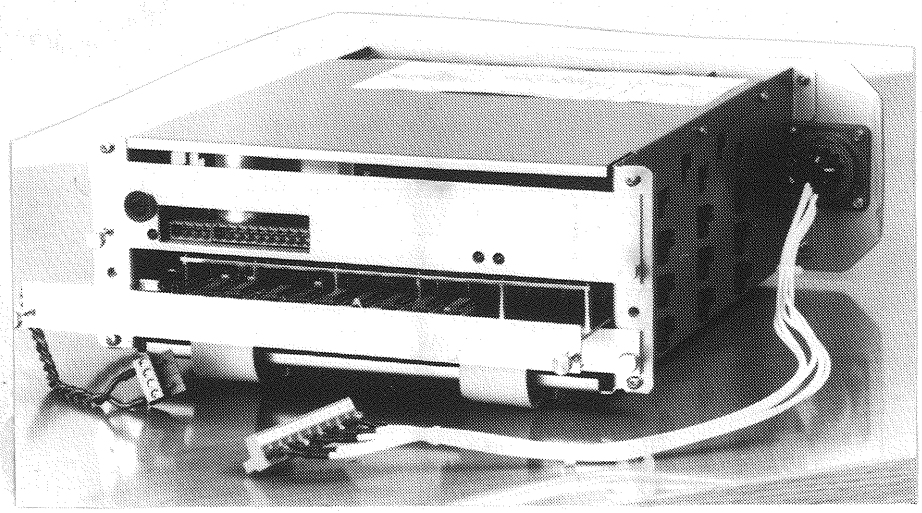
5.3 REPLACING THE PCB MODULES.

The PCB modules are, from top to bottom:

Analog transceiver
Digital transceiver
PC interface

First remove the plugs as shown in the figure. If the upper module is to be replaced, it is recommended to first pull out the module in the middle. Loosen the two screws holding the module to be removed and pull it out.

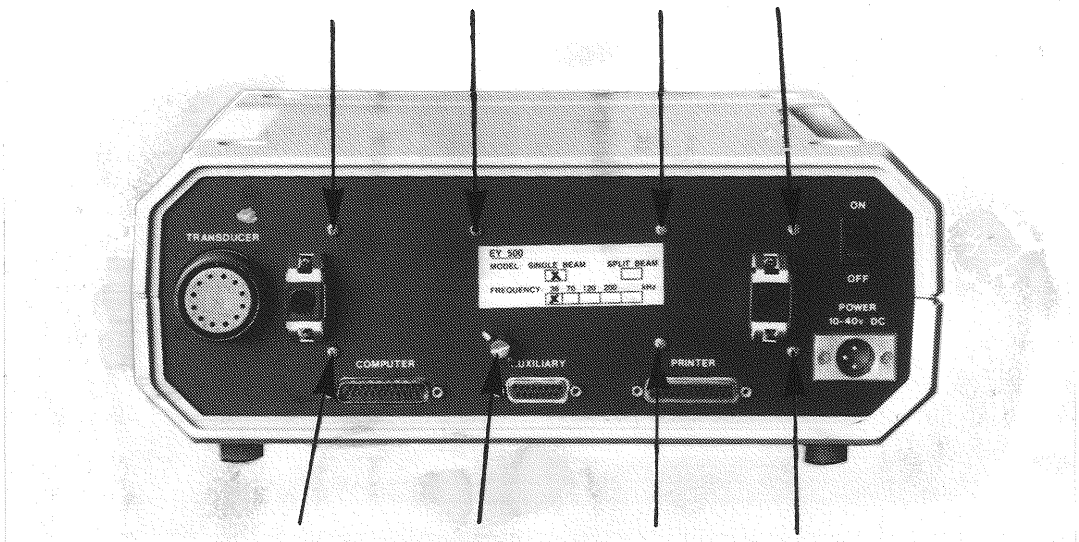




5.4 REPLACING THE DC POWER SUPPLY.

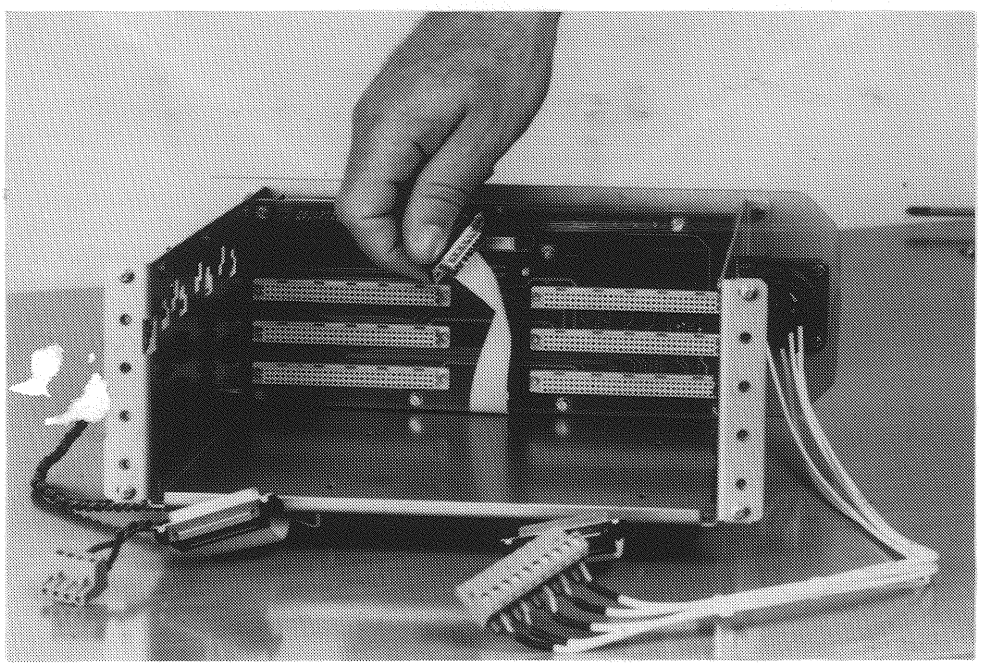
The power supply is located behind the rear panel.

1) Unscrew 8 screws on the rear panel



2) Remove all three PCB modules as described in paragraph 5.3

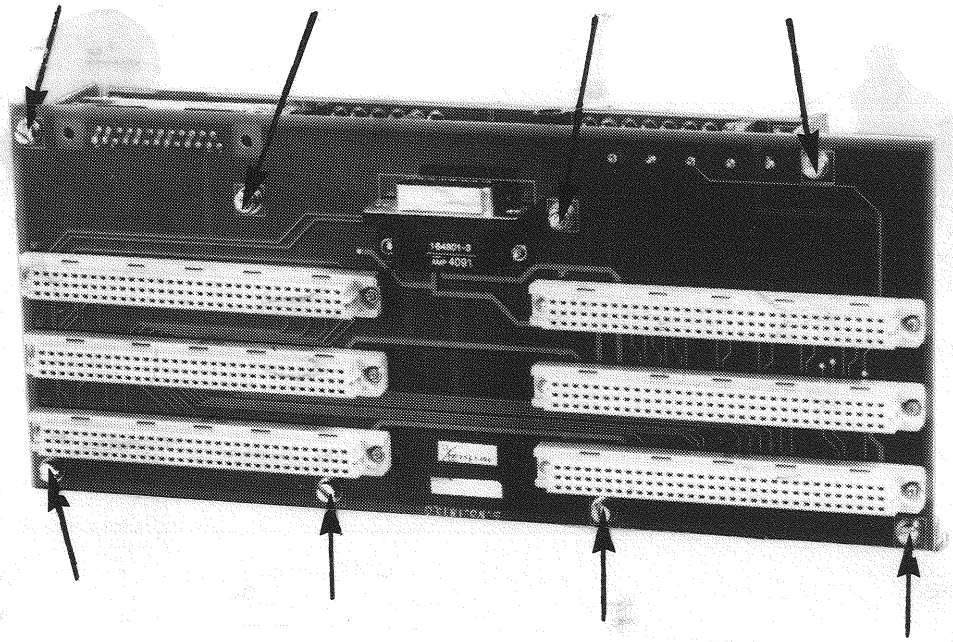
3) Pull out the ribbon cable plug from the motherboard



4) Pull out the power plug from the socket located behind the ON/OFF switch on the rear panel.

5) The power supply with motherboard can now be removed

6) If the motherboard and the power supply are to be separated, unscrew six screws and two nuts. The motherboard and power module are then only fastened together by a 25-pin Delta connector which easily can be disconnected.



6 MESSAGES

6.1 INTRODUCTION

The echo sounder may issue alarms, errors, warnings and other messages to the display and external devices (via serial port/disk).

6.2 LIST OF MESSAGES

Message	Explanation
Bottom lost alarm 1	Bottom tracking lost for transceiver
Display not ready	Display overload (may occur if system unable to update display with the current ping rate)
Illegal remote parameter	Parameter value of received remote command out of range or not recognized
Internal error 1-6	*
Internal error 7	Spurious interrupt
Maximum depth alarm 1	Bottom has been detected deeper than the maximum depth alarm setting
Minimum depth alarm 1	Bottom has been detected shallower than the minimum depth alarm setting
Navigation telegram error	Invalid navigation telegram received
Ping interval warning	Ping interval time exceeded
Printer-1 not ready	Printer-1 not connected, offline or not ready to print yet
Rem. annotation received	Remote annotation has been received successfully
Remote command ignored	Remote control received while remote control disabled
Remote parameter entered	Remote parameter received, decoded and entered successfully
Remote request executed	Remote request has been executed successfully

Message	Explanation
Serial Com. load warning	Too much data is directed to serial port, data may soon be lost
Serial Com. overload	Too much data is directed to serial port, data is lost
Serial-line 1 error	PC COM2 failure
Unknown error	An unexpected software error has been detected. Should be reported to Simrad
Unknown remote command	Invalid remote command path/parameter received
Unknown transceiver type	Transceiver hardware switch not recognized

* = Internal software problem. Should be reported to Simrad.

6.3 ERROR MESSAGES CONCERNING SIGNAL PROCESSING (SP)

6.3.1 Introduction

The software consists of a signal processor module and a control processor module. The signal processor module reads the control parameters sent by the control processor module before initiating a new ping. The program will then test each parameter against its legal values. If the parameter is found to be illegal, or the value does not agree with the other settings, an error message code is sent to the control processor which will issue the error message.

At power up the signal processor will never start real pinging until all the parameters are granted. However, in order to receive new information from the control processor, it will simulate pinging until no errors occur.

If the error message "SP-1 not responding error" is shown on the display, the signal processor has not answered within a timeout period. This error is probably caused by one of the following hardware errors:

1) No cable connection between PC and transceiver.

2) Transceiver is not turned on.

3) Hardware error in transceiver.

4) Mismatch between PC and parallel port or not enough memory.

6.3.2 List of error messages concerning signal processing

Error message	Legal values
SP-1 angle sensi. error	0 to 100 el./mech.
SP-1 bandwidth error	0 to 1
SP-1 beamtype error	0 to 1
SP-1 btm. max. depth error	0 to 20000 m
SP-1 btm. min. depth error	0 to 1000 m
SP-1 btm. min. level error	-80 to 0 dB
SP-1 damping coeff. error	0 to 300 dB/km
SP-1 display data error	See note I
SP-1 equ. beam angle error	-100 to -1 dB
SP-1 frequency error	10^4 to 10^6 Hz
SP-1 layer data error	See note III
SP-1 not responding error	See paragraph 6.3.1
SP-1 ping mode error	0 to 3
SP-1 printer-1 data error	See note I
SP-1 pulse length error	0.03 to 10 ms
SP-1 sample interval error	0.01 to 0.5 m
SP-1 sample tg error	0 to 1
SP-1 sound velocity error	1400 to 1700 m/s
SP-1 transceiv. mode error	0 to 3
SP-1 transd. depth error	0 to 1000 m
SP-1 transd. gain error	1 to 100 dB
SP-1 transd. param. error	See note II
SP-1 transmit power error	0 to 10 kW
SP-1 TS max. comp. error	0 to 6 dB
SP-1 TS max. length error	0 to 10

Error message	Legal values
SP-1 TS min. length error	0 to 10
SP-1 TS min. level error	-100 to 0 dB
SP-1 TS phase devia. error	0 to 10

Note I

SP-1 display data error
SP-1 printer-1 data error

The above error messages will occur if one or more of the following parameters are outside legal limits:

Parameter	Legal values
Bottom echogram dots	0 to 500
Bottom range	0 to 100 m
Bottom range start	-100 to 100 m
Echogram dots	0 to 700
Range	0 to 2500 m
Range start	0 to 2500 m
Sub-bottom gain	0 to 5 dB/m
TVG	0 to 2

Note II

SP-1 transd. parameter error

The above error message will occur if one or more of the following parameters are outside legal limits:

Parameter	Legal values
Alongship offset angle	-20 to 20 mechanical degrees
Athwartships offset angle	-20 to 20 mechanical degrees
Three dB bandwidth	0 to 50 mechanical degrees

Note III

SP-1 layer data error

The above error message will occur if one or more of the following parameters are outside legal limits:

Parameter	Legal values
Layer margin	0 to 10
Layer start	-100 to 20000
Layer stop	-100 to 20000
Layer type	0 to 3

6.3.3 Error messages concerning disk storage

Disk error 0
File not found
Replay end of file
Replay data not found
Replay bad data
File create error
File open error
File write error
File close error

7 SPARE PARTS LIST

Apart from stock number and a description of the required component, remember to include the name of the equipment, type designation and serial number.

7.1 TRANSCEIVER

Printed circuit boards

Type				**Stock number**
Transceiver (Analog transceiver)	Frequency (kHz)	Power (W)	Beam type	
	38	250	Single	382-074983
	38	250	Split	382-073377
	49	250	Single	382-056149
	70	50	Single	382-109214
	70	50	Split	382-065458
	120	60	Single	382-074984
	120	60	Split	382-082822
	200	60	Single	382-074985
	210	20	Single	382-109762
	710	50	Single	382-108879
Digital interface (Digital transceiver)				382-073500
PC interface				382-109289
DC power supply				290-109905
Backplane				382-109325

CALIBRATION OF THE EK 500 / EY 500

P2260 / 859-043867 / AA011

This document contains calibration procedures, procedures to determine the beam compensation in a split-beam system and procedures for noise measurements at sea.

Document revisions

Rev	Documentation department		Hardware/Software Design		Project/Product Management	
	Date	Sign	Date	Sign	Date	Sign
A	01.02.91	-				
B	31.08.92	-				
C	01.10.93	-				
D	28.05.96	CL	29.05.96	RLN	29.05.96	RB
E	20.05.97	Cl	20.05.97	HS	20.05.97	RLN

List of contents

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2 CALIBRATION PROCEDURE 6

3 THE LOBE CALIBRATION PROGRAM 17
3.1 UNPACKING AND STARTUP 17
3.2 OPERATING PROCEDURE 18

4 NOISE MEASUREMENTS AT SEA 24

Document history

(The information on this page is for Simrad's internal use)

Revisions:

Rev. A Original issue
Rev. B Minor changes to the text.
Rev. C Minor changes to the text. EY 500 implemented.
Rev. D Various changes in the procedures. A chapter about the lobe calibration program is added. Ref. EM 10526.
Rev. E Some uneccessary information removed from pages 16-17, and a few minor corrections made on page 6, 8, 15 and on the Calibration Report sheet.

1 THE PURPOSE OF CALIBRATION

The EK 500 and EY 500 are scientific echo sounders designed for quantitative measurements, i.e. measurement of single fish target strength and measurement of biomass backscattering coefficient. During the calibration a reference target with a known target strength is lowered into the sound beam, and the measured target strength is compared with the known target strength. If it is necessary to adjust the echo sounder, this is performed by changing a parameter in the mathematical equations in software. Since the echo sounder is digital right from the receiver front end, there is no analog gain adjustment.

The reference target is normally a metal sphere. Simrad supplies copper spheres, one for each frequency. The sphere diameter is selected for minimum temperature dependence.

For acoustic surveys where accurate quantitative measurements are required it is essential that the echo sounder is correctly calibrated. It is a safe practice to perform the calibration before and after the survey. If experiences over time show that no adjustments are necessary, it may be appropriate to reconsider the need for frequent calibration. Simrad recommends that calibration is performed at least once a year, and in areas with different summer and winter condition at least twice a year.

In the following calibration procedure typical settings on the EK 500/EY 500 are specified:

Ping Interval:	*1 sec.*
Transmit Power:	*Normal (applies only for EK 500)*
Pulse Length:	*Medium*
Receiver Bandwidth:	*Wide*
Transducer Depth:	*0.0 m*

If other settings are to be used during the survey, the calibration should be repeated for these.

A lobe program which can be supplied from Simrad makes the TS gain calibration procedure a relatively uncomplicated task by using an extra PC connected to serial line 1 in a split-beam system. This program will be noncritical with respect to movement of the reference target sphere and it will enable the inexperienced operator to obtain a good calibration result. This program should be used whenever possible. This procedure is described in chapter 3.

2 CALIBRATION PROCEDURE

Check the hardware installation

Check that the transducer cable is connected to the correct transducer plug on the rear side of the EK 500 / EY 500.

Check the internal test oscillator

Select the Transceiver Menu and set *Mode* to *Test*.

Select the Operation Menu and set *Ping Mode* to *Normal* and *Noise Margin* to *0 dB*.

Select the Test Menu/Transceiver.

The amplitude of the internal test oscillator is now displayed. It should be -55 dB ±2 dB re 1W on a split-beam sounder and -61 dB ±2 dB re 1W on a single-beam sounder. If the amplitude is outside these limits, disconnect the transducer cable and check the amplitude to see if the fault is in the transducer or in the receiver. The amplitude should now be -49 dB ±2 dB re 1 W on a split beam sounder, and -55 dB ±2 dB re 1 W on a single beam sounder. If the amplitude is still outside the limits, the problem is probably related to the receiver. If it is inside the limits, the transducer impedance should be checked.

Rigging

The following rigging description is to a great extent reproduced from ICES report 144. The vessel should be anchored in calm and sheltered water. The depth must be sufficient for separation of sphere and bottom echoes. It is desirable, moreover, to work in water as deep as possible, consistent with maintaining a stable platform. Both bow and stern anchoring or tying are recommended. This is illustrated in figure 1.

Placing of winches

Winches should be used to guide and steer lines to the sphere for its centering in the echo sounder beam. Affix these winches to the deck railing in accordance with detailed ship drawings. Place the first winch in the transverse plane of the vessel running through the transducer. If the transducer is mounted on one side of the keel, place the first winch on the opposite side of the vessel. Place the second and third winches on the same vessel side as the transducer and at equal distances from the transverse section containing the transducer and first winch.

Each winch must be provided with a long spool of 0.60 mm diameter mono-filament nylon line, which is marked with small swivels at 5 m intervals, beginning 10 m from the loose end.

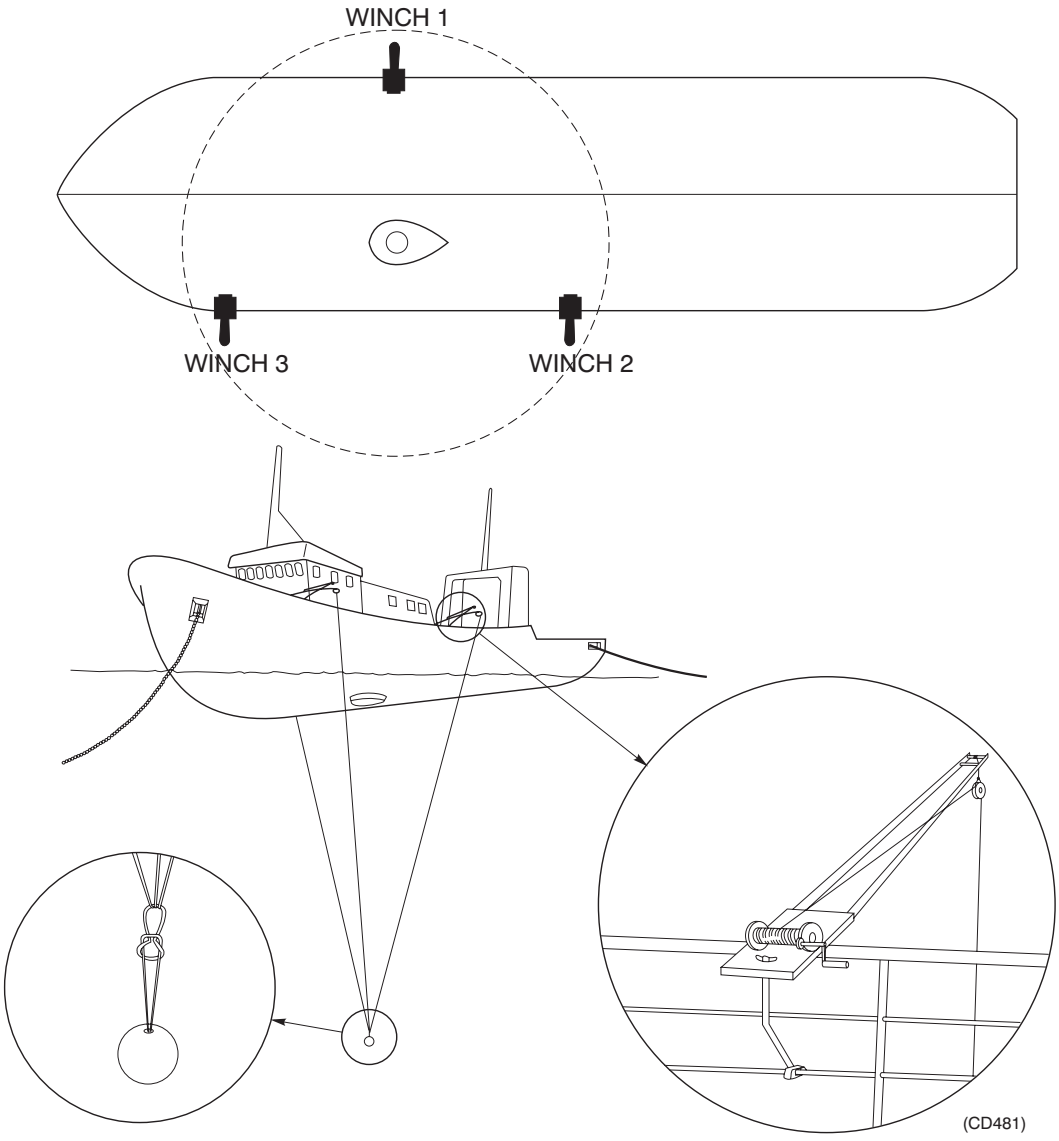

Figure 1 Rigging of a vessel for sphere calibration.

The purpose of the swivels is threefold:
- to unravel rotation of the nylon line
- to mark distances on the line
- to add weight so that the line sinks in water

Attaching the sphere
Prior to commencing the sphere measurements, a rope should be drawn beneath the hull from the first winch to the second and third winch before anchoring. Use this rope to pull the line from the first winch beneath the hull to the side with the second and third winches.

Attach the appropriate sphere, with affixed loop, to the three suspension lines, refer to figure 1. For the smaller spheres it may be necessary to add a weight to keep the sphere stable. This is done via a second line attached to the three suspension lines. The length of the line must be at least two pulse lengths, so that the echo from the additional weight does not interfere with the sphere echo. Immerse the sphere in a solution of dishwashing detergent and freshwater and lift it overboard by the fastened lines without touching it. The soap helps to eliminate air bubbles attached to the sphere.

Lowering the sphere
Lower the sphere beneath the vessel to the desired distance, for example 25 m, which is determined roughly by counting the swivels on each line.

In general, one should use sphere distances of 15 m or more for 38 kHz or higher frequencies. This in order to reduce the effect of pulse rise time and resolution in distance measurements on the calibration results. Software version 5.30 has corrected for these effects on the TS and s_A calibration.

Two further considerations in choosing the range are the transducer beamwidth and vessel geometry. The physical width of the beam, which increases linearly with range, should be sufficiently great so that the sphere echo is unaffected by the small, perhaps pendular movements to which it is inevitably subjected. The minimal range must also be convenient with respect to the vessel geometry. In particular, if the suspension lines do not hang freely, then control of the sphere may be hindered by friction or possible obstructions on the hull. Despite the number and variety of these considerations, it is seldom difficult in practice to find a suitable range which satisfies all of the above criteria.

Reference target.

Simrad supplies copper spheres designed as reference targets for the calibration of scientific sounders. Copper is selected because it is a metal which can be made electrolytically with high purity. The spheres are machined to the perfect spherical form with great accuracy, and a nylon loop is attached. Except for 12 kHz, 49 kHz and 50 kHz, the sphere diameter is different for each frequency in order to obtain a target strength with minimum dependence of temperature (K. Foote 1983). A curve showing the variation of the target strength follows each sphere. The curve for the 38 kHz sphere is shown below as an illustration.

Simrad copper spheres

Frequency kHz	Diameter mm	TS sound at speed 1490 m/s dB
12*	45.0	-40.4
18	63.0	-34.4
27	42.0	-37.9
38	60.0	-33.6
49*	45.0	-36.4
50*	45.0	-36.2
70	32.1	-39.1
120	23.0	-40.4
200	13.7	-45.0
710	10.3	-50.5

* same sphere

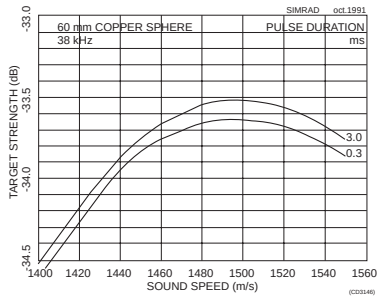

Figure 2 Target strength of a 60 mm copper sphere.

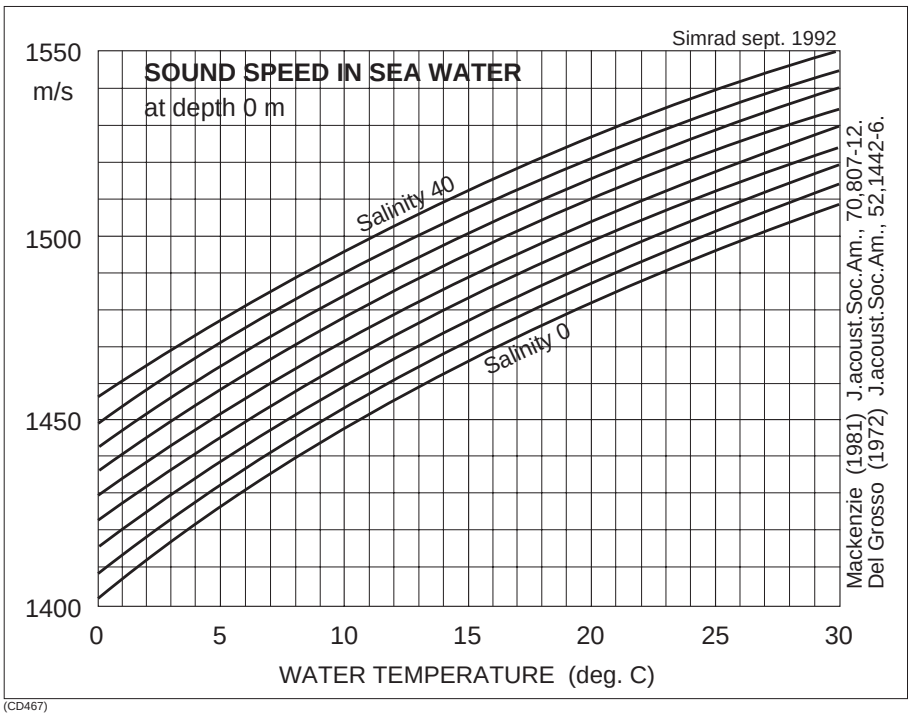

Figure 3 Sound speed in water.

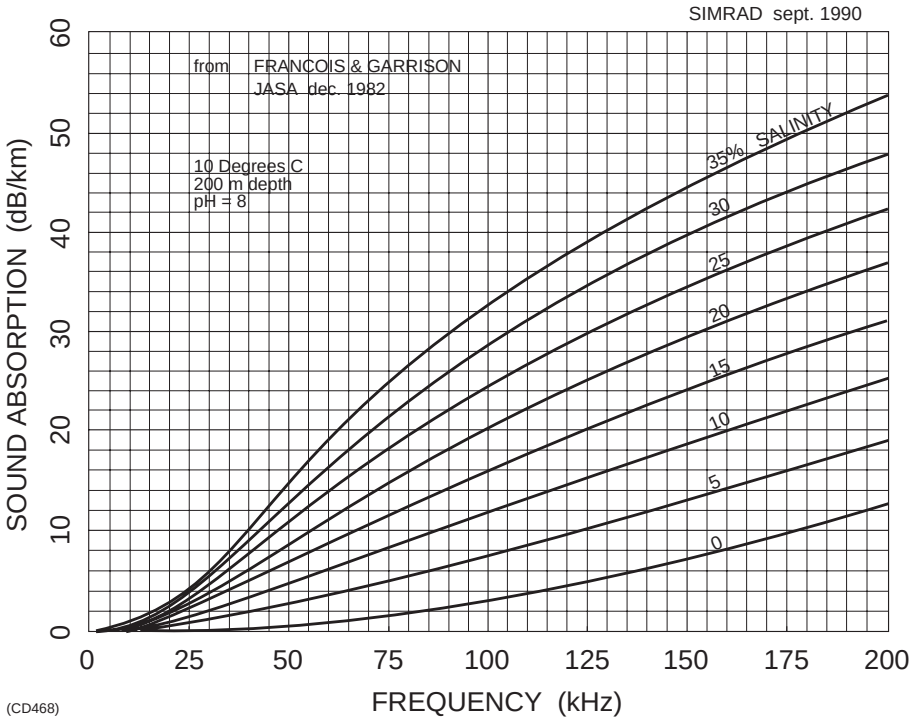

Figure 4 Sound absorption.

Centering of split beam

The purpose of this operation is to move the immersed, suspended sphere onto the acoustic axis of the transducer. First the echo sounder must be set so that the echo from the sphere is visible on the display.

Note that in the following procedures, references to transceiver 1, 2 and 3, and printer 1, 2 and 3, only apply to the EK 500 echo sounder. The EY 500 only uses one transceiver and one printer.

Select the Transceiver Menu and set:

Mode:	*Active*
Pulse Length:	*Medium*
Bandwidth:	*Wide*
Transducer Depth	*0.0 m*

Select the Operation Menu and set

Ping Mode:	*Normal*
Ping Interval:	*1.0 sec.*
Noise Margin:	*0 dB*

Select the Display/Echogram Menu and set

Range:	Select a range from the sea surface to well below the sphere
Range Start :	*0 m*
Auto Range:	*Off*
Bot. Range Pres.:	*Off*
Presentation:	*Normal*
Layer Lines:	*On*
Integration Lines:	*10 000*
TVG:	*40 log r*
TS Colour Min:	*-50 dB*

Select the Log Menu and set

Mode:	*Ping*
Ping Interval:	*100*

Select the Layer Menu and set

Super Layer:	*1*

Select the Layer Menu/Layer-1 Menu and set

Type:	*Surface*
Range: *Range Start:*	The layer must be wide enough to cover the sphere echo during the movements in the centering operation. Otherwise it should be as narrow as possible, in order to exclude disturbing fish echoes. Be sure that also the bottom echo as well as the trailing edge of the transmitter pulse and the echo from the additional weight are outside the layer.
Margin:	*0.0 m*
Sv Threshold:	*-80 dB*
No. of Sublayers:	*1*

The rest of the main layers should be turned off.

Select the TS-Detection Menu and set

Min. Value:	*-50 dB*
Min. Echo Length:	*0.8*
Max. Echo Length:	*1.8*
Max. Gain Comp.:	*6.0 dB*
Max. Phase Dev.:	*2.0*

The best value for the sound velocity (profile) should be set in the Sound Velocity Menu in order to keep the accuracy as high as possible for the calibration exercise.

If the sphere is in the beam an echo will now be seen as a steady line in the echogram. If the sphere furthermore is inside the -6 dB limit on the beam, the echo will show up as a dot on the TS detection window on the left-hand side of the screen. This horizontal projection makes it easy to see which way the sphere must be moved to reach the beam center. Movement of the sphere occurs by turning of the various hand winches, always one winch at a time and on specific command by the director of this procedure, who is guided by constant observation of the echo on the screen.

Centering of single beam

In a single beam system there are different methods to position the sphere in the centre of the beam. In this system the reference sphere, when detected as a single target, will always appear in the beam centre. Use the TS detection window to observe the TS value and adjust the position of the reference sphere for maximum TS value.

A second method is useful if a single beam transducer is located close to a split beam transducer. When the distance between the centre of the single and split beam transducers is known, the reference sphere can be positioned using simple geometry.

Choose the split-beam transducer in the Transceiver Menu, use the TS detection window and position the reference sphere in the centre of the beam as previously described (when the sphere is in the centre of the beam, both the *Angle Along* and the *Angle Athwart* in the TS window will be zero degrees).

Calculate the angle α by means of the information regarding the distance between the two transducers and the distance between the sphere and the transducers. Refer to figure 5.

$$tg\alpha = \frac{d}{r}$$

d = distance between single beam and split beam transducers
r = distance between the sphere and the transducers
α = refer to the figure

If, for example, the single beam transducer is located 0.6 m directly behind the split beam transducer, the sphere must be moved straight aft until the *Angle Along* shown in the TS detection window is the same as the calculated angle α. During the movement, the sphere must be kept at the same distance from the transducer.

The *Angle Along* corresponds to the calculated angle α and when these angles are equal, the sphere will have moved 0.6 m and be in the centre of the beam of the single beam transducer.

Now operate the system with the single beam transducer and read the TS value in the TS detection window. To check that the sphere is in the centre of the beam, move the sphere slightly in the athwartships and fore-and-aft directions and check for increasing or decreasing TS value.

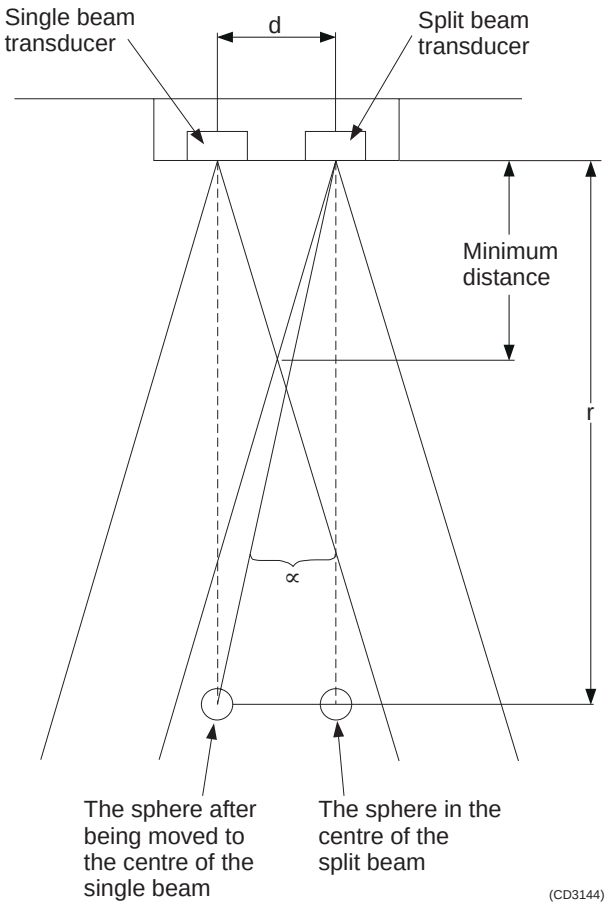

Figure 5

The Scope mode may be useful during this process as well. The scope plot starts at the beginning of the super layer, and the horizontal axis contains 200 depth samples. Accordingly, this depth scale is different for the different frequencies. Check that the sphere is well within the super layer. Select the Test Menu, *Scope* and a dynamic range for the plot (50 dB). Then select the highest amplitude value to be included in the plot (-50 dB). The sphere echo should now appear on the scope plot. Reduce the dynamic range to give a high vertical resolution and adjust the highest amplitude to give a convenient plot where the peak sphere echo reaches the horizontal centre line on the scale. Then move the sphere in the transversal and longitudinal directions until the maximum amplitude position has been found.

Use the TS detection window for single beam to read maximum TS value.
Look at the echogram and check that you have, from the top:

- transmitter pulse
- upper layer limit (red line)
- sphere echo
- lower layer limit (red line)
- echo from the additional weight (if used)
- bottom echo

all well separated, and no other echoes within the layer limits.

TS-measurement

Select the TS-Detection Menu to get the horizontal projection window. With the sphere in the center of the beam, the TS compensated and the TS uncompensated should be identical. These values are read on the screen underneath the horizontal projection window. If there is a small difference use the TS compensated value as the measured TS value. It is recommended that the measured TS value is logged together with other important information. A recommended form is attached at the end of this document.

If the measured TS value differs from the known TS value of the sphere, then calculate a new TS transducer gain:

$$\text{New transd. gain} = \text{Old transd. gain} + \frac{\text{TS measured} - \text{TS sphere}}{2}$$

Select the new *TS Transducer Gain* in the Transceiver Menu and check that the measured target strength is correct.

In software version 5.20 and higher, TS values have been corrected for TVG inaccuracies because of the sample intervals and the pulse rise time.

s_A - measurement

The calibration of the TS-measurement described in the previous paragraph is the primary calibration and it will in many cases be a sufficient calibration. The TS-measurement, however, is based on the peak value of the echo samples in the sphere echo, whereas the s_A-measurement is based on integration (averaging) of the echo samples. The received echo may have a smoothed rise and decay. Therefore the algorithm for calculation of s_A in the sounder uses an effective pulse length rather than the nominal pulse length. A test, and if necessary, a calibration of the s_A calculation may be carried out according to the following procedure.

Check the cable connection to colour printer-1.
Switch on colour-printer-1.

Select the Printer1 Menu and set

Integrator Tables:	*Number of the transceiver in use (if EK 500)*
Echogram:	*Slave*

The echogram recording will then be similar to the one at the display.
Read the measured s_A-value, the red number in the integrator table after each log interval. Calculate the theoretical s_A-value as follows:

TS sphere = target strength of the sphere

σ_{bs} = backscattering cross section of the sphere

$\sigma_{bs} = 10^{TS\ sphere/10}$

r = distance between the transducer and the sphere
(read from the display screen, underneath the horizontal projection window).

Ψ = equivalent 2-way beam angle
(from the measurement data delivered with the transducer)

$\Psi = 10^{dB\text{-}value\ /\ 10}$

$$s_A\ (theory) = \frac{4\pi r_0^2 \cdot \sigma_{bs} \cdot (1852\ m/nm)^2}{\Psi \cdot r^2}$$

where r_0 = 1 meter is the standard reference distance for backscattering.

If the measured s_A-value differs from the theoretical value, this can be corrected by changing the *S_v Transducer Gain* in the Transceiver Menu. Calculate a new transducer gain:

$$\text{New transd. gain} = \text{Old transd. gain} + \frac{10 \log (s_A(measured)/s_A(theory))}{2}$$

Enter the S_v transducer gain in the Transceiver Menu, and the measured s_A-value will be correct.

The calibration report form at the end of this appendix may be used for recording calibration conditions and results.

3 THE LOBE CALIBRATION PROGRAM

3.1 UNPACKING AND STARTUP

This software package greatly simplifies the task of determining the optimum transducer pattern parameters to be used in the EK 500/EY 500 Transceiver Menu. The program runs on IBM PC/XT/AT's and compatibles. It is strongly recommended to have a mathematics coprocessor (8087/80287/80387) installed in the computer to speed up the estimation and plotting algorithms.

This software is distributed free of charge to all Simrad EK 500/EY 500 customers. A self-extracting archive contains
- C source code files
- makefile for automatic compilation/linking
- the executable lobe calibration program
- example transducer measurement data files
- archive program with user's manual
- this manual (manual.doc)

The C source code was compiled with a Borland Turbo C++ 1.01 compiler.

The procedure for unpacking the archive files is straightforward. Insert the Simrad distribution diskette in the A drive. Create an empty directory on the hard disk and copy the archive file to the empty directory. Move to the new directory and execute the self-extracting archive program.

```
mkdir lobedir
copy a:*.* lobedir
cd lobedir
lo950117.exe (or older version with different date)
```

After completion of the archive program the "lobedir" directory contains all the unpacked files.

To start the lobe calibration program, type

```
lobe.exe
```

at the DOS prompt. The function keys F1 to F5 select different operational menus.

F1. To quit the lobe calibration program.

F2. Serial port 1 is used for communication with the EK 500. For the EY 500 connect to the serial line on the PC and set /Utility/Com1/Com2 Switch = On)

This menu sets the communication parameters. The RS232 cable coupling diagram is shown on the computer display.

F3. To record the reference target detections from the EK 500/EY 500 into a measurement data file. Horizontal hit position and vertical target depth are displayed.

A simulation mode is available for demonstration and training purposes by starting the lobe calibration program with an option parameter
lobe.exe -s

F4. To view the true transducer pattern. A two-dimensional polynomial of the fourth degree is least square fitted to the measured data points and displayed. Please observe that the polynomial model has more freedom to adjust to the measured data points than the EK 500/EY 500 internal transducer model. Hence, the polynomial model should be used to view the true transducer pattern.

F5. The internal transducer model of the echo sounder is least-square fitted to the measured data points and displayed. The optimum pattern parameters are automatically loaded into the echo sounder using the remote control commands via the RS232 connection.

3.2 OPERATING PROCEDURE

Connect an RS232 serial line cable between the PC and Serial Port 1 on the EK 500 and the serial line on the PC for the EY 500.

Type F2. The plug connections will then be given on the computer display.

Check that the echo sounder Serial/USART Menu has settings corresponding to those given in the LOBE RS232 Menu. Refer to figure 6.

Switch on the echo sounder and select the Serial/Telegram Menu and set *Remote Control* to *On*. Follow the instructions previously given for Centering of split beam until the sphere appears as a steady line in the echogram and the sphere is positioned in the centre of the beam and at a suitable distance from the transducer.

Switch on the PC and start the LOBE program. Then the LOBE program will enter necessary menu settings in the echo sounder and read necessary parameters from same. While the sounder is operating, check that the RS232 serial line connection is active by typing F2.

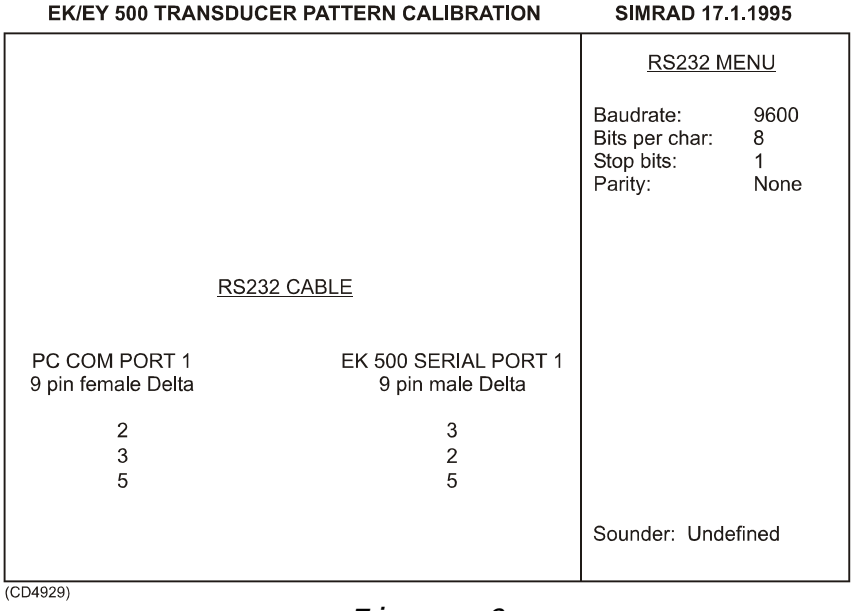

Figure 6

Type F3. The display will show previously saved calibration files. The cursor will appear at the end of the comment file on top of the display.
Erase the comment string and enter your comments concerning the present calibration. In the Record Menu you have to fill in a new *File Name* and *Transceiver Number* according to the setting in the sounder (if EK 500). The transceiver number is selected by means of the horizontal arrow keys. The correct TS for the calibration sphere according to actual sound velocity has to be entered in addition to the Depth reading from the TS Menu provided that the *Transducer Depth* has been set to *0.0 m*. Refer to figure 7.

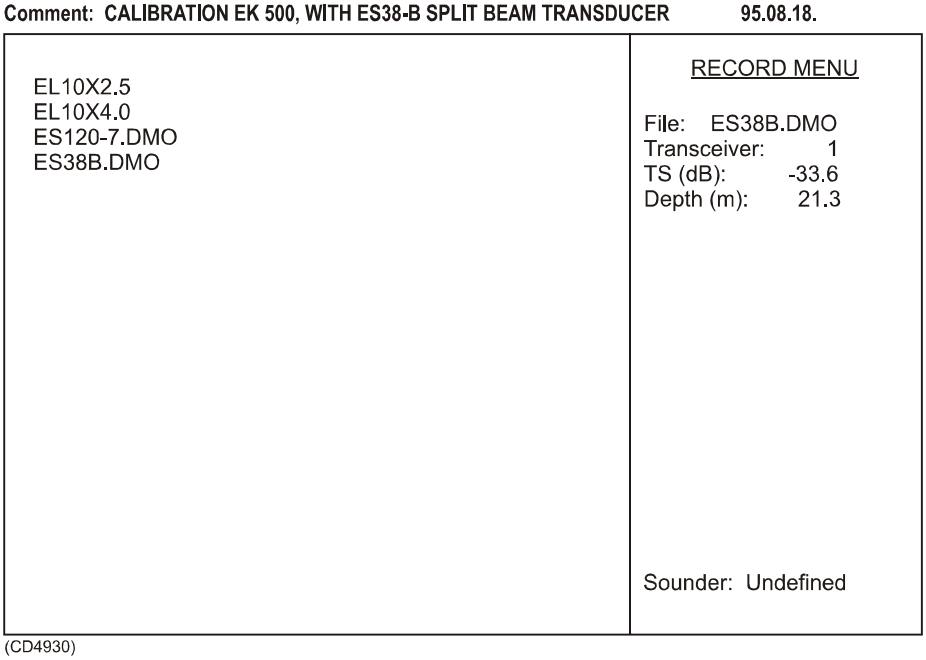

Figure 7

The LOBE program will set up "windows" around TS value and Depth. The TS window is ±4 dB and the Depth window is ±10%. TS samples outside the windows will be rejected. When starting the calibration, check that the measured TS value is well within the window. If it is close to the limit, you may, when moving the sphere, easily end up with TS values outside the window that will be rejected. To avoid this you should readjust the *TS Transducer Gain* in the echo sounder's Transceiver Menu until the reading is closer to the correct TS value. Then the LOBE program has to be restarted by typing CR/LF and then F3. This is because the LOBE program has to collect the new settings from the echo sounder. The Depth window is shown as the green part of the red bar on the left hand side of the PC display. The present depth of the reference sphere is shown as the white dot on the right hand side of the bar. Refer to figure 8.

Then move the reference sphere slowly to collect TS data sets until the file contains sufficient number (>100) of samples evenly distributed inside the 4 quadrants of the beam pattern. The present or last position of the sphere inside the beam is shown in white colour (black) and the recorded samples are blue (grey). The recorded number of Data Sets is shown. When the file is completed, stop collecting data by typing CR/LF.

If the TS of unwanted objects like fish is recorded, note the sample numbers when these are recorded. Before processing the recorded data, use an editor to delete the data recorded from these unwanted echoes. They can be located using the sample numbers noted, obviously incorrect TS or/and Depth values appearing incidentally.

When suspect data has been removed, type F4 to check the true transducer pattern. If this appears to be non-consistent with the expected shape or with considerable offset values or other anomalies, the possible cause has to be revealed before the calibration can be completed. The reason may be the transducer or the transceiver unit.

If acceptable data has been recorded, type F5. The processing of the collected data will start and the number of iterations is shown at the lower end of the Fit Menu. When reaching approximately 50 iterations, the processed data will remain even and the processing can be stopped by typing CR/LF. In the Fit Menu there is a Relative Angle given in % (° in old versions). 150 % means all accepted samples are being used in the calculation. If the operator would like to check the beam pattern for a reduced angle, decrease the setting by using the horizontal arrow keys. Reducing to 100 % the calculation will only use samples inside the -3 dB circles.

In the Fit Menu the rms deviation between calculated beam pattern and the collected data sets will be given as well as the minimum and maximum deviation and where these data sets are recorded in the file. The max. and min. values are shown by a red and a blue cross in the polar diagram. The recorded max. and min. samples should be removed by using the editor if the deviations are more than approx. 1 dB. Note the line numbers to locate these unwanted data. All the remaining data sets are shown in the polar diagram by red and blue dots. The red ones are those above the calculated beam pattern, the blue are those below. A cut through the beam can be shown for 0, 45, 90 and 135 degrees by typing F1, F2, F3 or F4. Refer to figure 9.

The final calibration data for TS Gain, Beam and Offset values are calculated and shown in the Fit Menu. These data should preferably be logged in the recommended form at the end of this document.

By typing CR/LF one more time, the PC will ask if the operator wants to "Copy best fit parameters to EK 500 (y/n) ?". When typing y, the calculated data will be entered into the Transceiver Menu. If the echo sounder is already in the Transceiver Menu, leave this and enter the same menu again to have the new settings displayed.

When the reference sphere is located in the centre of the beam after the calibration has been completed, the TS value in this position may be a little higher than the correct TS. This is more perceptible using old versions of the LOBE program with a little bit different algorithm.

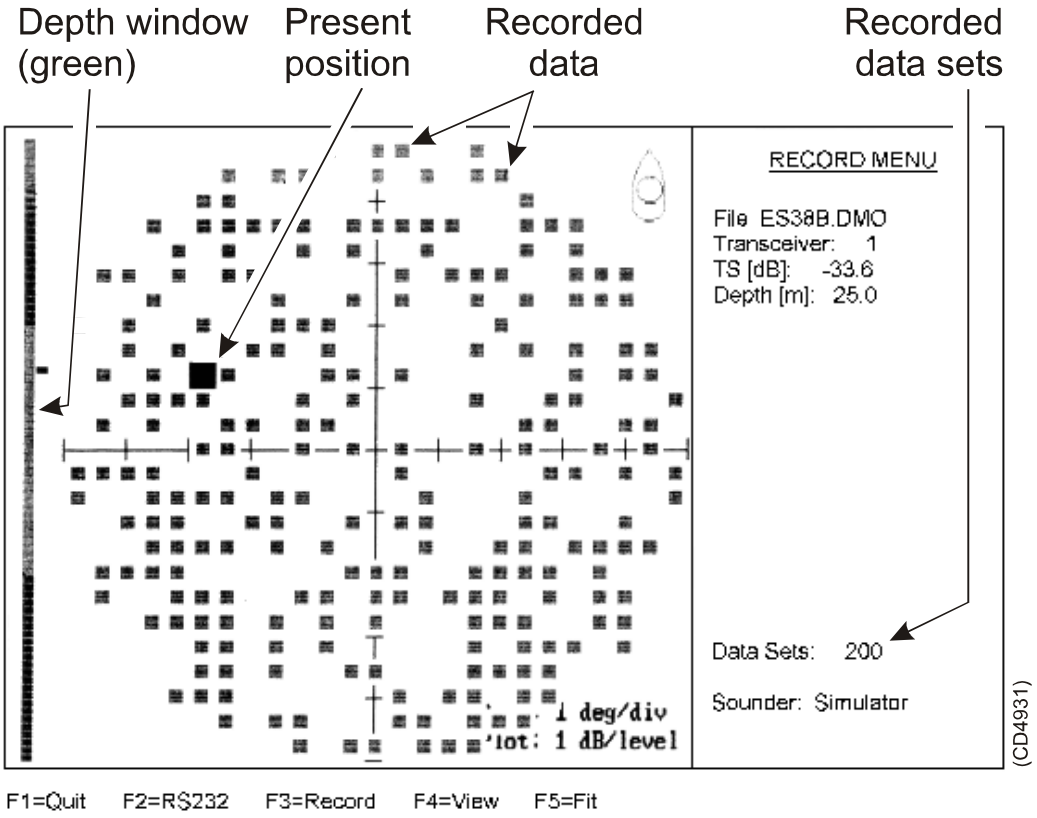
Depth window (green)
Present position
Recorded data
Recorded data sets
RECORD MENU
File ES38B.DMO
Transceiver: 1
TS [dB]: -33.6
Depth [m]: 25.0
Data Sets: 200
Sounder: Simulator
1 deg/div
Plot: 1 dB/level
(CD4931)
F1=Quit F2=RS232 F3=Record F4=View F5=Fit

Figure 8

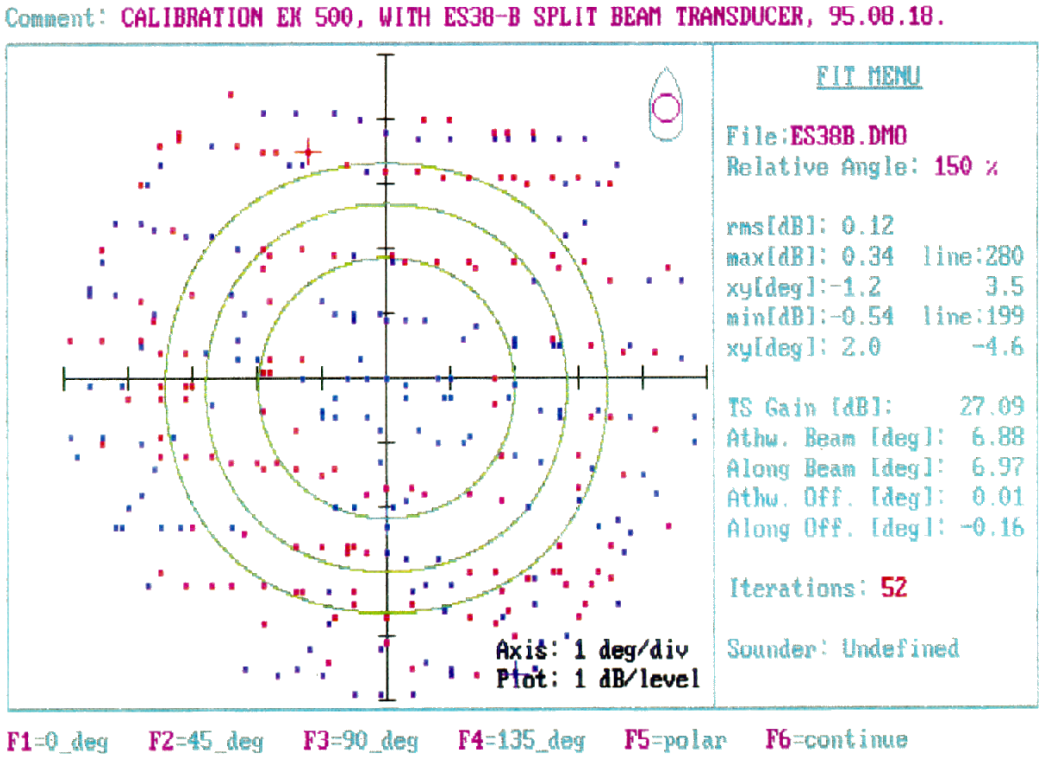
Comment: CALIBRATION EK 500, WITH ES38-B SPLIT BEAM TRANSDUCER, 95.08.18.
FIT MENU
File:ES38B.DMO
Relative Angle: 150 %
rms[dB]: 0.12
max[dB]: 0.34 line:280
xy[deg]:-1.2 3.5
min[dB]:-0.54 line:199
xy[deg]: 2.0 -4.6
TS Gain [dB]: 27.09
Athw. Beam [deg]: 6.88
Along Beam [deg]: 6.97
Athw. Off. [deg]: 0.01
Along Off. [deg]: -0.16
Iterations: 52
Sounder: Undefined
Axis: 1 deg/div
Plot: 1 dB/level
F1=0_deg F2=45_deg F3=90_deg F4=135_deg F5=polar F6=continue

Figure 9

4 NOISE MEASUREMENTS AT SEA

The final result of the noise measurements should be a plot of the acoustic noise in front of the transducer versus vessel speed. This plot may be compared with similar plots for other transducers on the same vessel, or plots from other vessels, and may thus serve as an evaluation of the transducer location and the vessel noise radiation. In addition, the noise plot may be a guide in choosing the vessel speed during acoustic surveys. Since the propeller pitch and revolutions per minute influence the noise level, it is important to determine the most favourable combination of these factors. Normally a slow rotation and a high pitch give the lowest noise.

The noise measurements should take place at least one nautical mile off shore, far from other ship traffic and and with favourable weather conditions. It is preferable that the water depth is 200 m or more. The noise should be measured at different vessel speeds, from 0 to maximum speed, with steps of 2 knots. The vessel's course must be kept steady during these measurements.

With the settings specified below, the printer will produce an echogram and an integrator table. With some experience it should be possible to reveal the noise source from looking at the echogram. Typical sources may be propeller cavitation, small damages on the propeller blade, the machinery, or thermal noise. It is a good routine to save the echogram with the integrator table for comparison with later recordings.

Select the Operation Menu and set:

Ping Mode:	*Normal*
Ping Interval:	*0.0*
Transmit Power	*Normal (only for the EK 500)*
Noise Margin:	*0 dB*

Select the Transceiver Menu/Transceiver-1 Menu (if the transceiver to be tested is transceiver No. 1) and set:

Mode:	*Passive*
Pulse Length:	*Medium*
Bandwidth:	*Wide*

Select the Transceiver Menu/Transceiver-2 Menu and set (only for the EK 500):

Mode:	*Off*

Select the Transceiver Menu/Transceiver-3 Menu and set (only for the EK 500):

Mode:	*Off*

Select the Log Menu and set:

Mode: *Ping*
Ping Interval: *200*

Select the Display Menu and set:

Echogram Speed: *1:1*
Echogram: *1*

Select the Display Menu/Echogram-1 Menu and set:

Range: According to table below
Range Start: According to table below

Frequency (kHz)	Range	Range Start
18	5000	0
38	1000	100
120	250	0
200	200	0

Auto Range: *Off*
Bot. Range Pres. *Off*
Presentation: *Normal*
Layer Lines: *On*
TVG: *20 log R*
Sv Colour Min. *-80 dB*

Select the Printer-1 Menu and set:

TS Distribution: *Off*
Integrator Tables *1*
Echogram: *Slave*

Select the Layer Menu and set:

Super Layer: *1*

Select the Layer Menu/Layer-1 Menu and set:

Type:	*Pelagic*
Range (layer thickness L)	*See table below*
Range Upper:	*See table below*
Sv Threshold	*-100 dB*
No. of Sublayers:	*1*

Frequency kHz	Range L m	Range Start m	2TL dB
18	50	3975	96
38	20	990	80
120	10	195	61
200	5	147,5	59,5

Range settings and transmission loss for different frequencies

Start the noise - speed trial with the vessel in a fixed position. Make a short echogram recording and an integration table for the same interval. Print a marker line when starting the recording and give the line a number that at the same time is logged in the noise-speed report form at the end of this document.

Print a second marker line at the end of the recording, connect the propeller and increase the speed to 2 knots. When the vessel has reached a stable speed, make a new echogram recording interval and integration table for the same interval. Continue the same procedure at 2-knot intervals until reaching maximum speed. Use marker lines to separate the different intervals. When at maximum speed, disconnect the propeller as quick as possible and print marker lines for each 2 knots as the speed decreases towards 0.

If the noise level quickly decreases towards the level at 0 knots as soon as the propeller has been disconnected, this means that the noise is generated by the propeller. If the recording at decreasing speed is more or less equal to the same noise level at increasing speed, the cause is probably flow-noise.

If the increase in level is propeller noise and this substantially reduces the performance of the sounder, repeat the tests with different combinations of pitch and propeller speed if possible, to find the most favourable conditions.

When making echogram recordings at different speed levels, select the Test Menu/Transceiver and read the noise power P_N re 1 W. Enter readings in the same form at the end of this appendix.

When the trial has been completed, the corresponding noise level, NL dB re 1 μPa can be calculated for both the recording procedures. The results from the two procedures might differ somewhat because of the different ways they are measured. The S_A method gives the average echo level from a volume of water during a specified time interval. The P_N method is from one individual power sample in each ping.
The equations for calculating from recorded data to NL is given below.

From S_A: (based on the sonar equation)

$$NL = S_i + 10 \cdot \log (P_{TX} \cdot S_A \cdot T / Z \cdot L) - 2TL + 10 \log \Psi - 75$$

NL	=	Noise level	dB re 1 μPa
S_i	=	Transducer transmitting response	dB re 1 μPa per A
P_{TX}	=	Transmitter power	W
Z	=	Transducer impedance	ohm
2TL	=	Two-way transmission loss	dB
L	=	Layer thickness	m
10 log Ψ	=	Equivalent two way beam angle	dB
T	=	Transmitter pulse length	msec

S_i , Z , and 10 log Ψ is from the data sheet for the specific transducer
For split beam transducers Z is for all four quadrants in parallel
P_{TX} and T is from the sounder specifications 2TL and L from the table on page 26.

From P_N:

$$NL = P_N - 20 \log \lambda - G + 192.8$$

λ =	wavelength = c/f	
c =	speed of sound = 1500	m per sec.
f =	frequency	Hz
G =	transducer gain	dB
	Read G in the Transceiver Menu/*S_V Transducer Gain*	

This noise level NL is comparable with the previous measurements on the EK 400 when the EK 400 calibration procedure was followed.

The theory for the derivation of the above formula for NL from P_N is given here, now using linear quantities (not dB):

P_N is received noise power	W
I_N is plane wave sound intensity in front of the transducer	W/m^2
A is the effective receiving area of the transducer	m^2

$P_N = I_N \cdot A$
G is the transducer gain = $4\pi A/\lambda^2$

n is the plane wave sound pressure in front of the transducer Pa

$n^2 = I_N \cdot \rho c$

ρ is water density = 1000 kg/m^3

c is the speed of sound = 1500 m/s

NL = 20 log n + 120 dB re 1 µPa

120 dB is introduced for conversion from Pa to µPa

For the reason of documentation it is recommended to record one scope plot at survey speed.

Select the Printer-1 Menu/Echogram-1 Menu and set:

Presentation: Scope.

When the scope printout has started, set:

Presentation: Normal

Repeat the measurement for transceiver 2 and 3 (if installed).

References

ICES Cooperative Research Report 144:
Calibration of acoustic instruments for fish density estimation: A practical guide.
ICES, Palægade 2, 1261 Copenhagen K, Denmark

ICES Fish Capture Committee 1981/B:20
Improved calibration of hydroacoustic equipment with copper spheres. By Foote, Knudsen, Vestnes, Institute of Marine Research, Bergen and Brede, Nielsen, Simrad Subsea Horten, Norway.

Journal of the Acoustical Society of America, March 1983.
Maintaining precision calibrations with optimal copper spheres By Ken Foote.

Ref. no	Revolutions		Propeller pitch	Vessel speed	Measured S_A	NL from S_A	Test menu NOISE	NL from test menu
.	Engine r.p.m.	Propeller r.p.m.		Knots	m^2/nm^2	dB re. 1 μPa	dB re. 1 W	dB re. 1 μPa
0		0		0				
1				Increasing				
2				2				
3				Increasing				
4				4				
5				Increasing				
6				6				
7				Increasing				
8				8				
9				Increasing				
10				10				
11				Increasing				
12				12				
13				Increasing				
14				14				
15				Increasing				
16				16				
17		Disconn.						
18		0						
19		0						
20		0						
21		0						
22		0						
23		0						
24		0						

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CALIBRATION REPORT EK 500 / EY 500

VESSEL:..... DATE:.....
PLACE:..... EK/EY 500 SERIAL NO:.....
TRANSDUCER TYPE:..... SERIAL NO.:..... FREQUENCY:..... KHZ
WATER TEMP:.....°C SALINITY:.....% SOUND VELOCITY:.....M/SEC.

Ping Interval	1	1	1	sec.
Absorption Coefficient				dB//km
Pulse Length	SHORT	MEDIUM	LONG	
Bandwidth				
Maximum Power				W
Transmit Power				
Angle Sensitivity Alongship (fore and aft)*				
Angle Sensitivity Athwartships*				
TS of Sphere				dB
Default TS Transducer Gain				dB
Measured TS				dB
Calibrated TS Transducer Gain				dB
Calibrated TS				dB
Default 2-Way Beam Angle				dB
Transducer data 2-Way Beam Angle				dB
Measured Distance Transducer - Sphere				m
Default Sv Transducer Gain				dB
Theoretical s_A				m^2/nm^2
Measured s_A				m^2/nm^2
Calibrated Sv Transducer Gain				dB
Calibrated s_A				m^2/nm^2
Default -3dB Beamwidth Along. *				degrees
Default -3dB Beamwidth Athw. *				degrees
Calibrated -3dB Beamwidth Along.*				degrees
Calibrated -3dB Beamwidth Athw.*				degrees
Alongship (fore-and-aft) Offset*				degrees
Athwartships Offset*				degrees

* Valid for split-beam transducers only

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DRAWINGS

P3406E / 857-160023 / 4AA062

This document contains the referenced drawings for maintenance of the echo sounder.

Document revisions

Rev	Documentation department		Hardware/Software Design		Project/Product Management	
	Date	Sign	Date	Sign	Date	Sign
A	25.08.95	CL	25.08.95	HS	31.08.95	RB
B	15.03.96	CL	18.03.96	EF	18.03.96	EF

List of Drawings

System interconnection diagram 824-111020 (652-05)

Power system 824-111079 (652-33)

Transducer connections 824-111021 (652-06)

Plug connection drawing 820-134006 (664-36)

Interconnection diagram 824-111019 (652-04)

Power distribution 824-111022 (652-07)

Motherboard diagram 824-109327 (643-32)

Interface PCB, circuit diagram 824-109291 (620-07)

Power supply, circuit diagram 824-109632 (640-74)

Sync. unit circuit diagram 824-133142 (627-15)

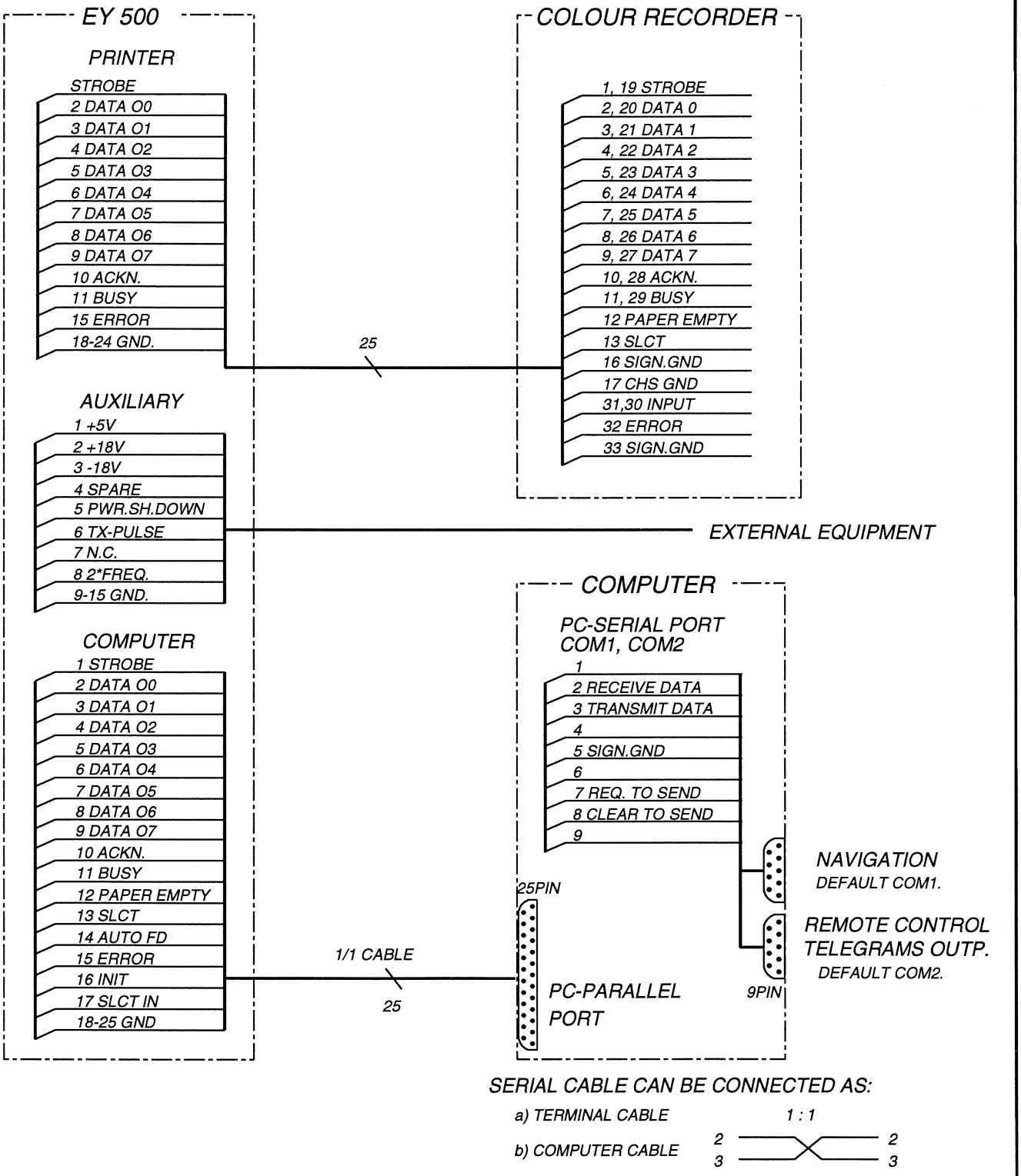
External sync. cable plan 824-133141 (871-08)

Document history

(The information on this page is for Simrad's internal use)

Rev. A Original issue

Rev. B The document is expanded to cover the portable echo sounders in the 500 Series; EA 501P and EY 500.



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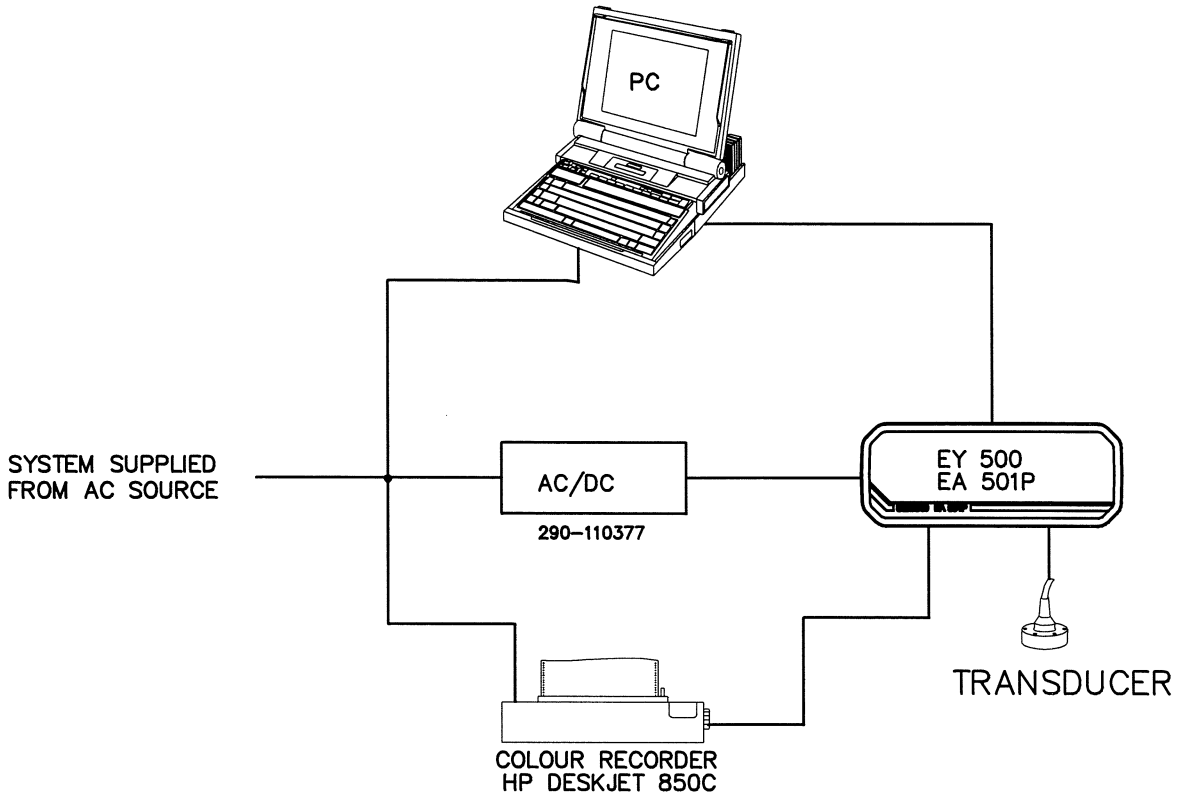
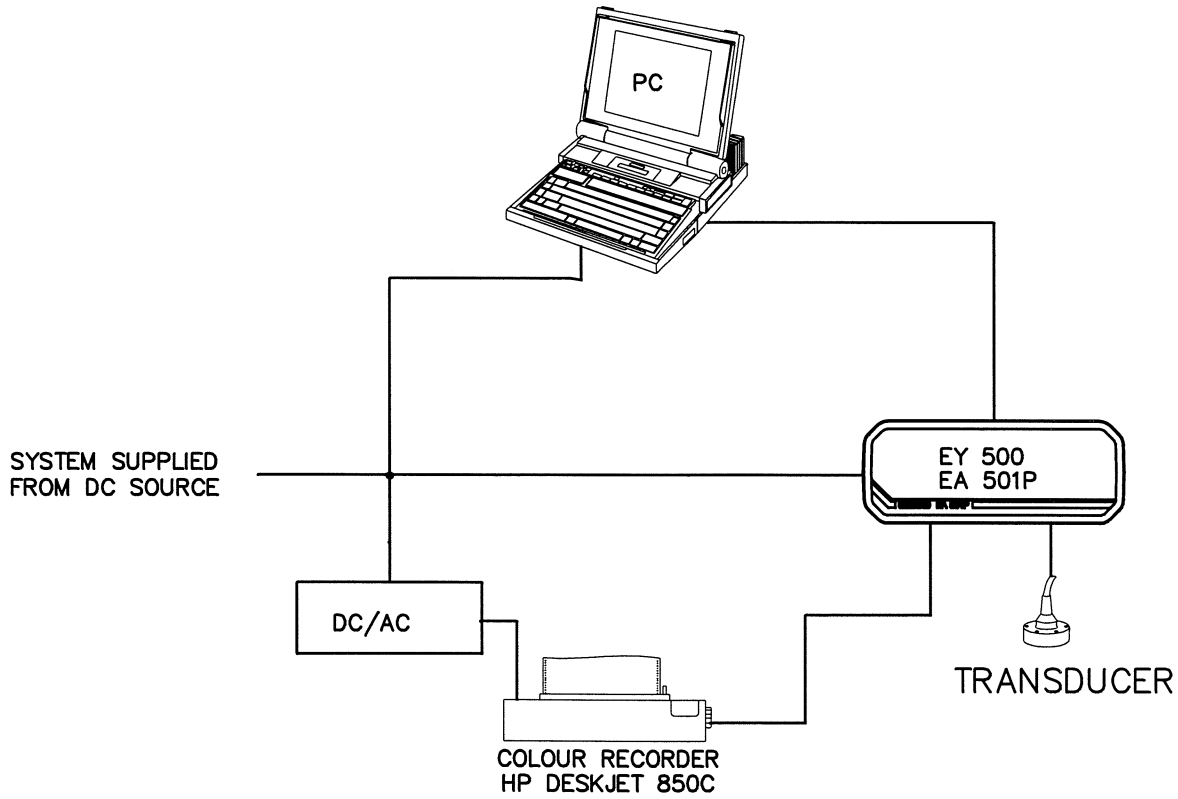
DATE	93.06.24.	93.06.24.							
							SIMRAD		
SCALE	NO SCALE		EY 500 SYSTEM INTERCONNECTION DIAGRAM				SHEET 1OF 1	SH.SIZE: A4	REV.:
DRAWN	93.06.11.	R.L.N.					824-111020		C
CHECKED	93.06.11.	H.S.							
APPROVED	93.06.11.	R.B.					FILE NO.: 652-5		





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DATE	960305									
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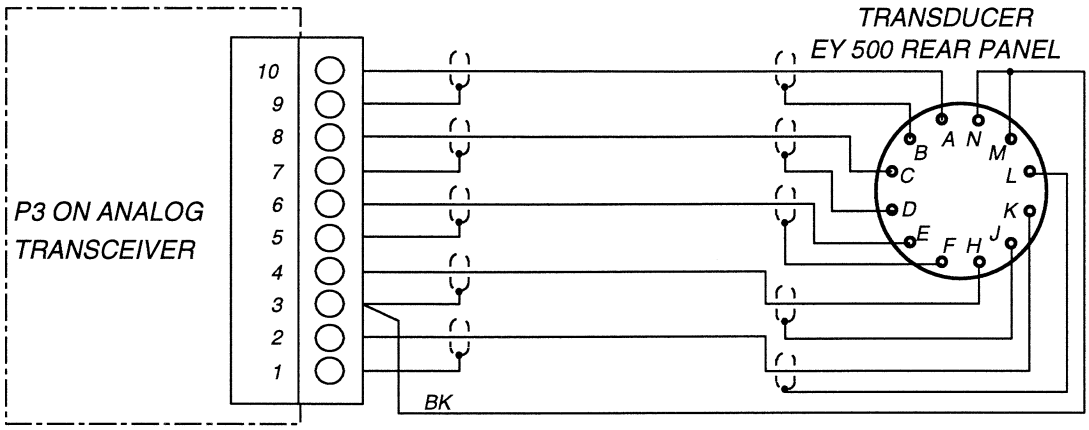
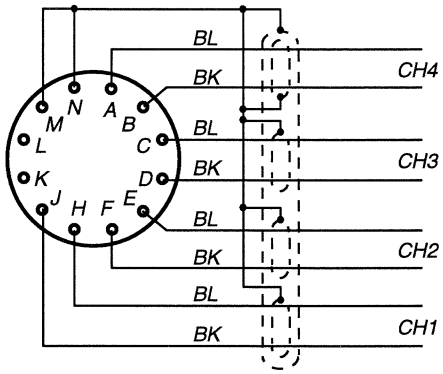
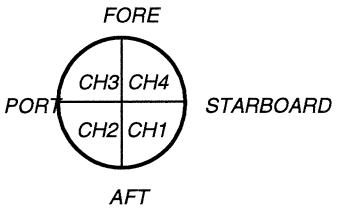
SCALE	1:1		POWER SYSTEM					SHEET 1 OF 1	SH.SIZE: A4	REV.:
DRAWN	930628	R.L.N						824–111079		B
CHECKED	930428	HS	EY 500 / EA 501P							
APPROVED	930428	RB						FILE NO.: 652–33		

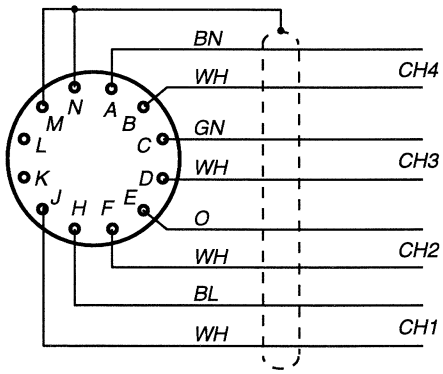


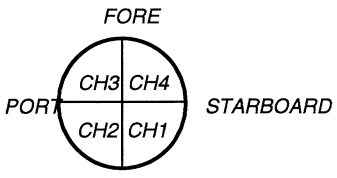


SPLIT BEAM TRANSDUCERS

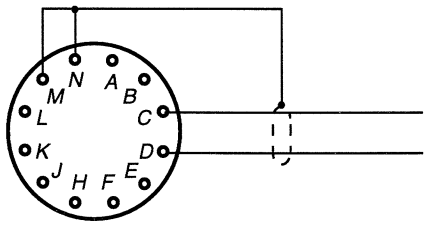


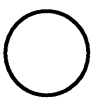
ALTERNATIVE CABLE TYPES



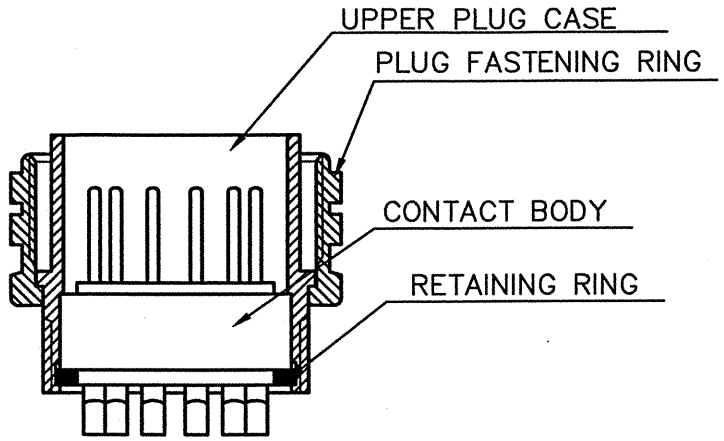


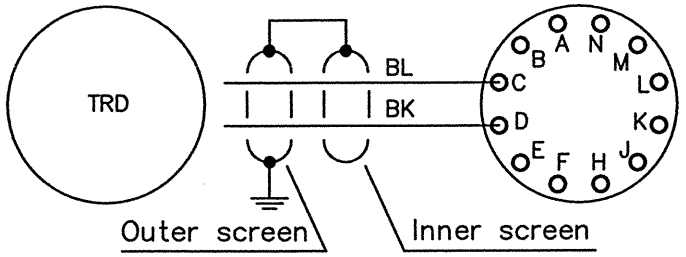
SINGLE BEAM TRANSDUCER



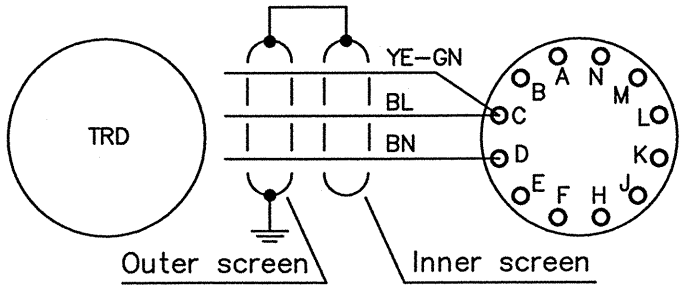


REV./SIGN.	9008/RLN.	9013/RLN.								
DATE	93.06.24.	93.06.25.								
							SIMRAD			
SCALE	NO SCALE		EY 500 TRANSDUCER CONNECTIONS				SHEET1 OF 1	SH.SIZE: A4	REV.:	
DRAWN	93.06.15.	R.L.N.					824-111021		C	
CHECKED	93.06.15.	H.S.								
APPROVED	93.06.15.	R.B.					FILE NO.: 652-6			





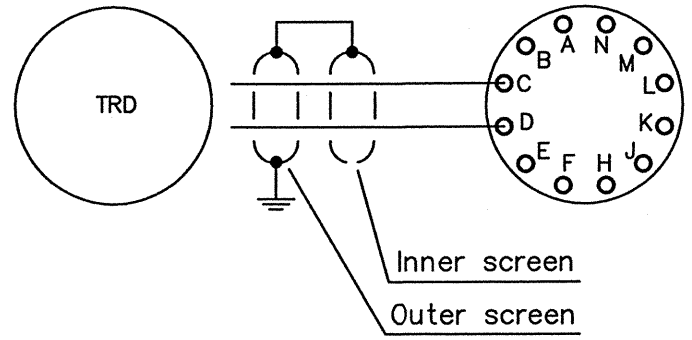
SINGLE FREQUENCY WIDE BEAM



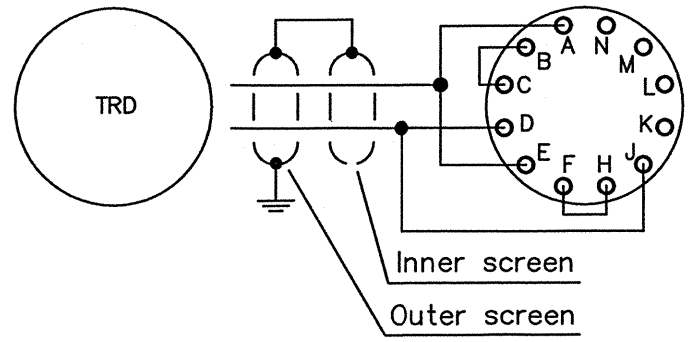
SINGLE FREQUENCY NARROW BEAM

DUAL BEAM TRANSDUCER
WARNING: Check transmit power if wide beam is selected.

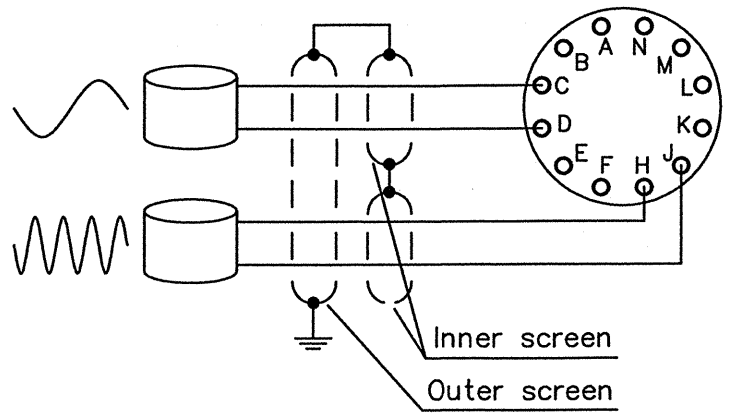
SINGLE FREQUENCY SINGLE BEAM

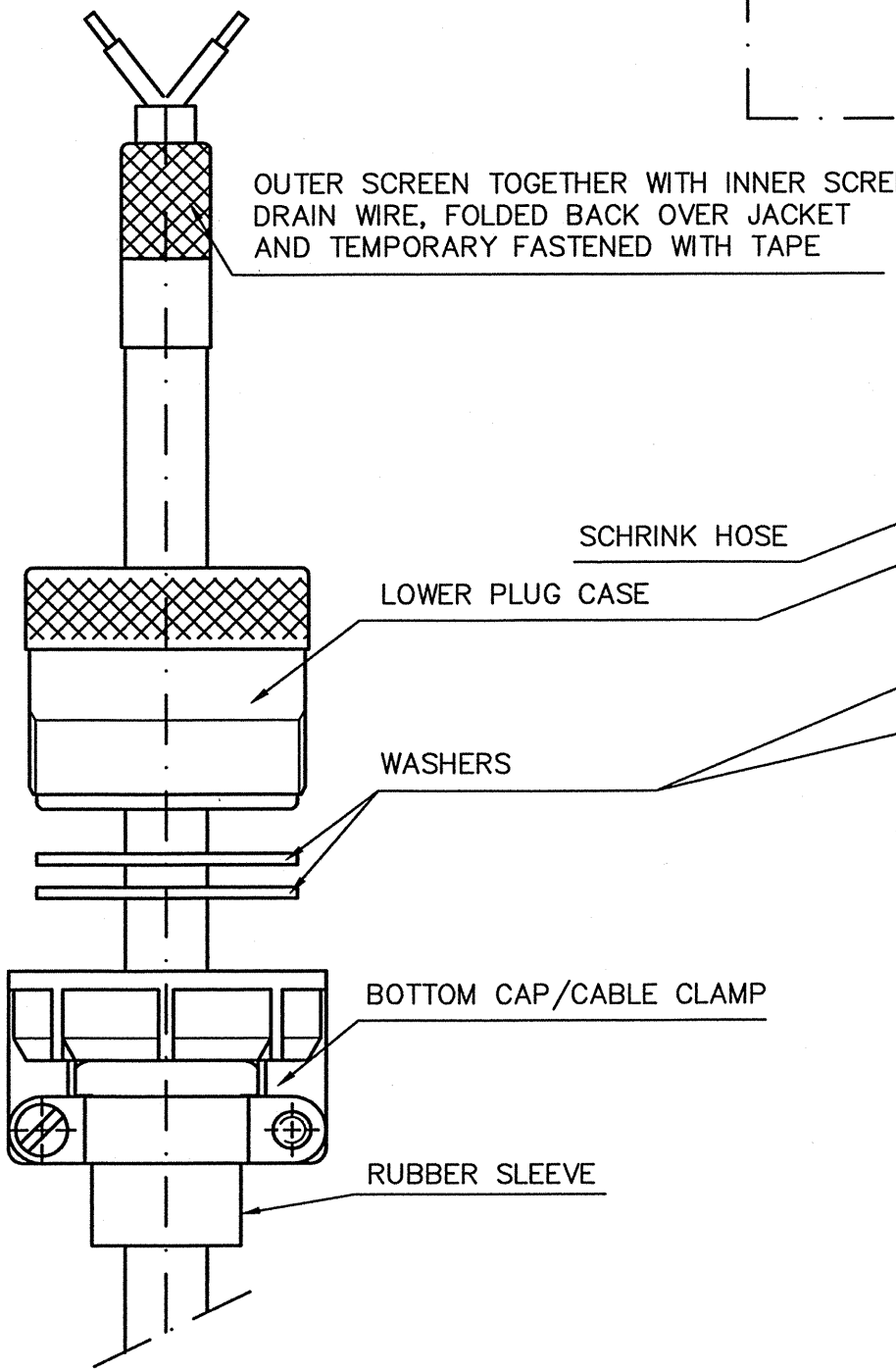


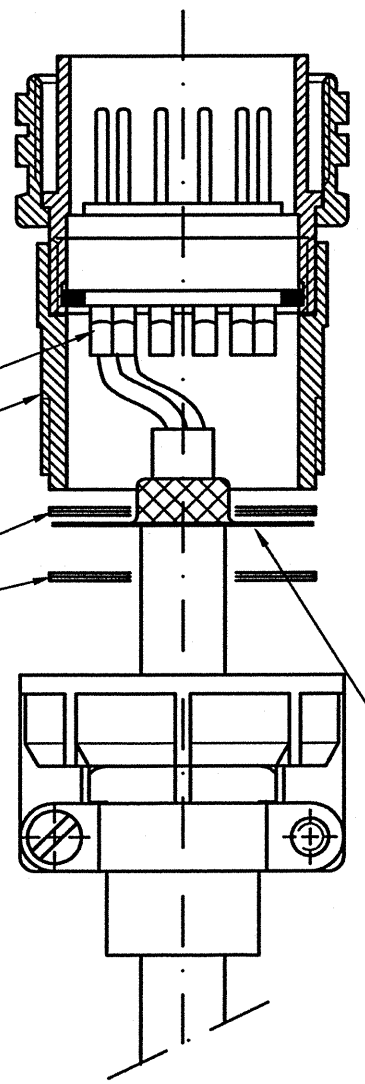
SINGLE FREQUENCY SINGLE BEAM 2/4kW
(EA400/ES60/EK60 ONLY)

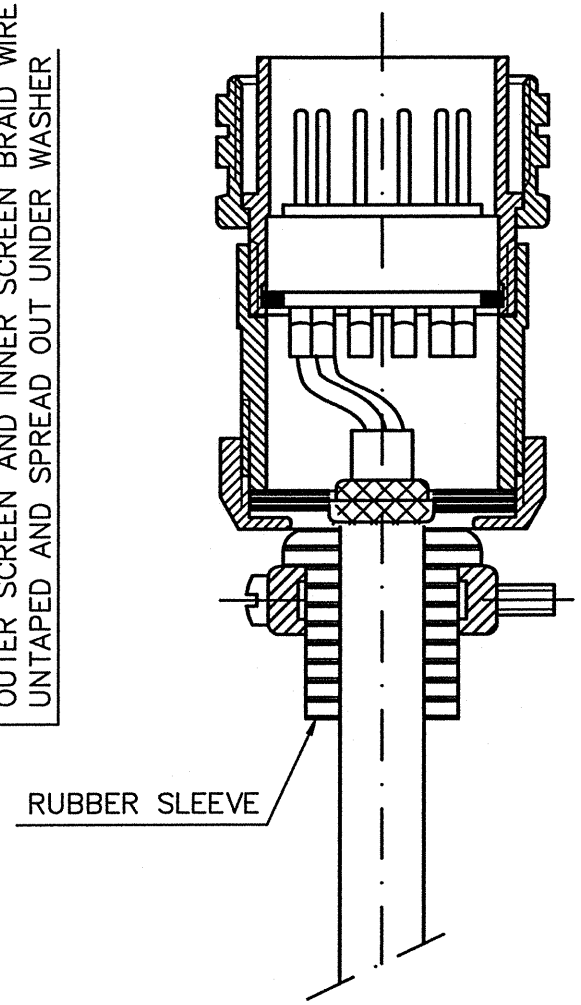


DUAL FREQUENCY SINGLE BEAM 1+1kW
(EA400/ES60/EK60 ONLY)

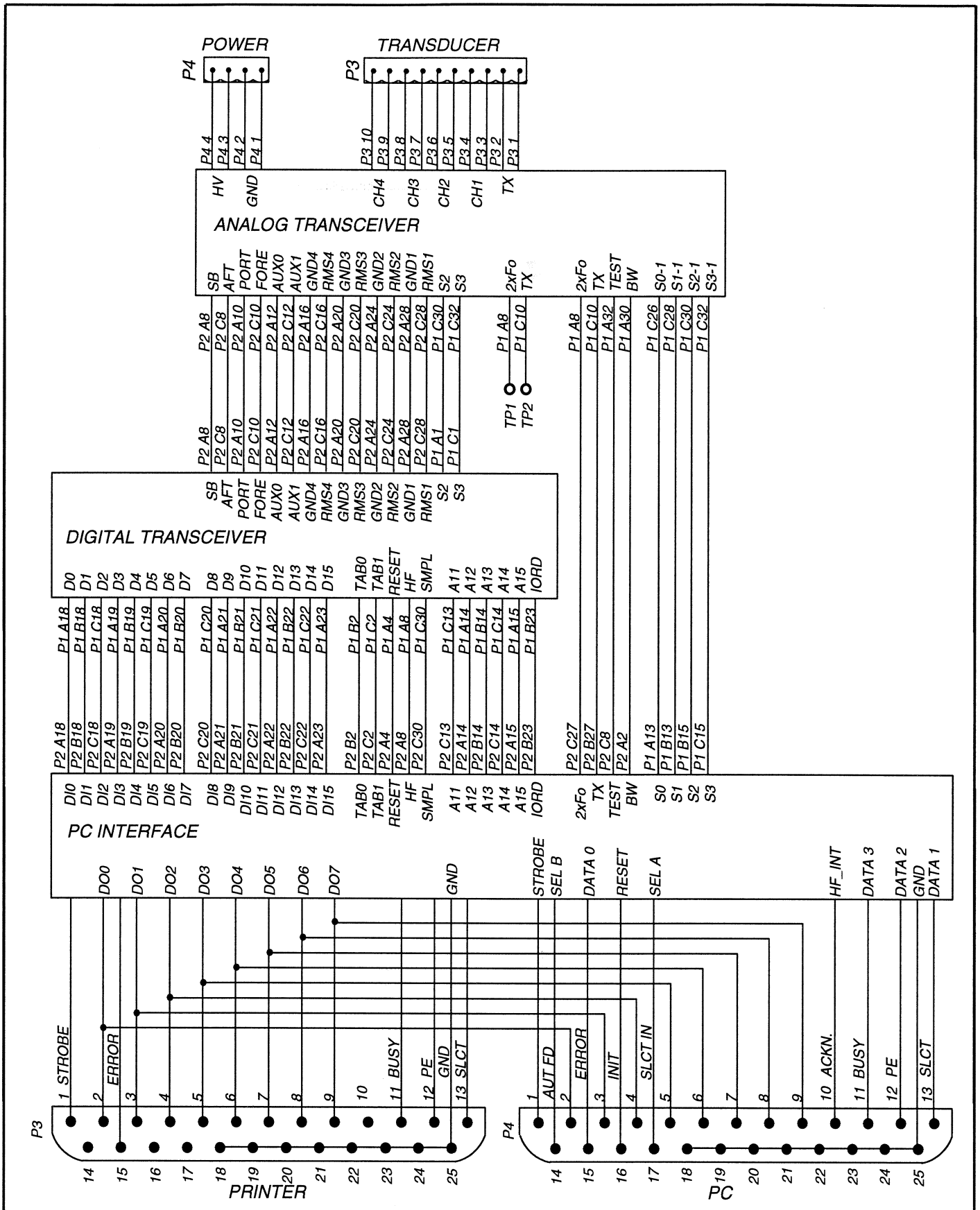








REV./SIGN.	B KSK	C KSK	D KSK						
DATE	99.01.27.	99.03.05.	99.12.07.						
PROJ. METHOD			UNLESS OTHERWISE STATED, TOLERANCE: DIM.: – THREAD: –				PARTS LIST:	SIMRAD A KONGSBERG Company	
SCALE	1:1		PLUG CONNECTION DRAWING				SHEET 1 OF 1	SH.SIZE: A3	REV.:
DRAWN	96.02.28	A.Aa.	SINGLE/DUAL BEAM TRANSDUCER				820–134006		D
CHECKED	96.02.29	E.En.	EA500/EK500/ES500/EY500				FILE NO.: 664–36		
APPROVED	96.03.01	E.F.	EA400/ES60/EK60						



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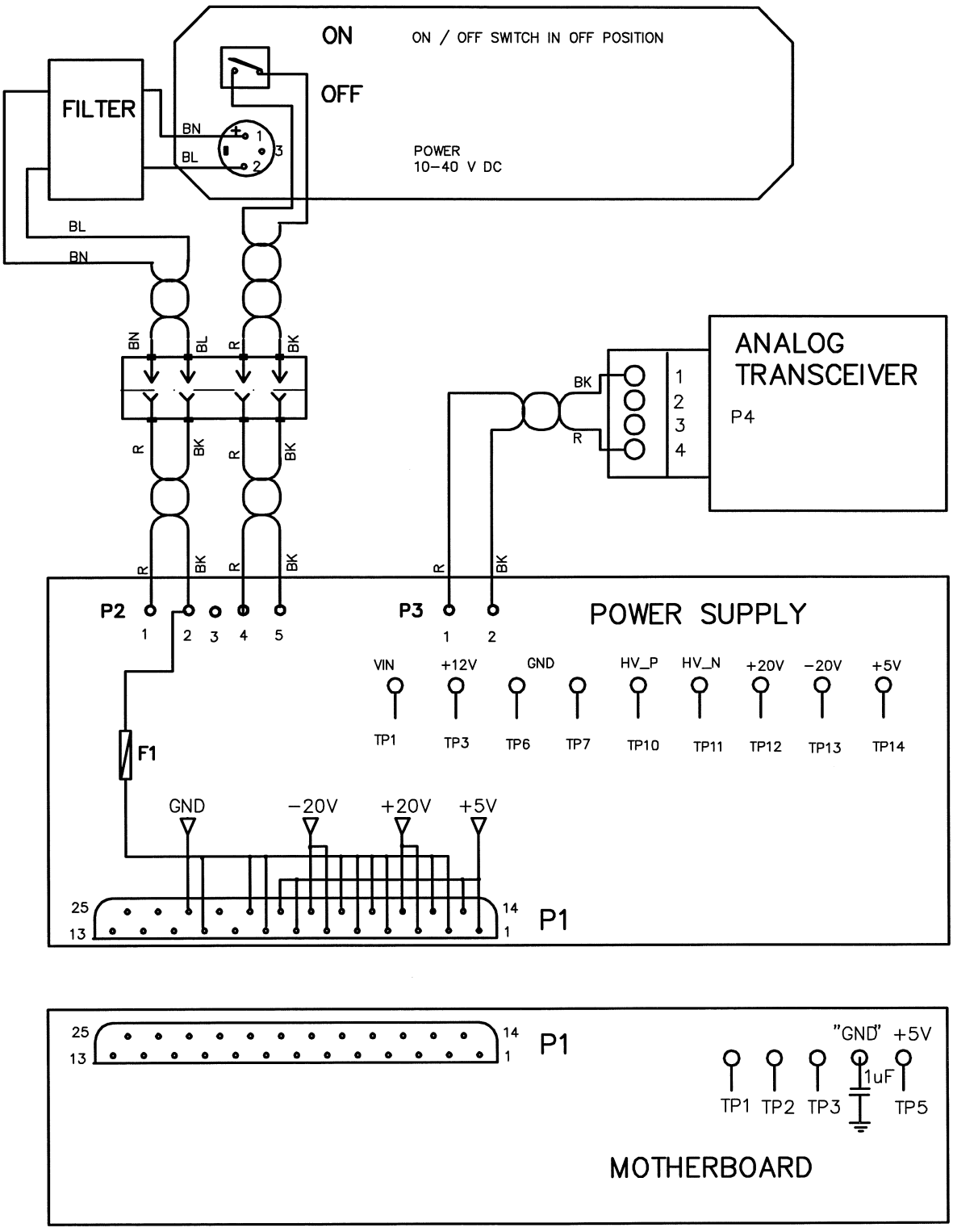
DATE	93.06.24.									
									SIMRAD	
SCALE			EY 500 INTERCONNECTION DIAGRAM					SHEET1 OF 1	SH.SIZE: A4	REV.:
DRAWN	93.06.15.	R.L.N.						824-111019		B
CHECKED	93.06.15.	H.S.								
APPROVED	93.06.15.	R.B.						FILE NO.: 652-4		



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DATE	930706	960305							
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SCALE	1:1		POWER DISTRIBUTION				SHEET 1 OF 1	SH.SIZE: A4	REV.:
DRAWN	930621	RLN					824-111022		C
CHECKED	930621	HS	EA 501P /EY 500						
APPROVED	930621	RB					FILE NO.: 652-7		

PC - INTERFACE

J1A 6 SPARE
J1C 6 TX
J1A 8 HF
J1A 13 S0
J1C 13 S1
J1B 15 S2
J1C15 S3
J1A 11
J1A 12
J1A 14
J1A 15
J1C 24
J1C 25
+5V
J1B 2
J1B 6
J1B 9
J1B 13
J1B 17
J1B 20
J1B 23
J1B 26
J1B 29
J1B 32
GND

DIGITAL TRANSCEIVER

J3A 1 S2
J3C 1 S3
J3B 2 TAB0
J3C 2 TAB1
J3A 4 RS
J3A 8 HF
J3C 13 A11
J3A 14 A12
J3B 14 A13
J3C 14 A14
J3A 15 A15
J3A 18 D0
J3B 18 D1
J3C 18 D2
J3A 19 D3
J3B 19 D4
J3C 19 D5
J3A 20 D6
J3B 20 D7
J3C 20 D8
J3A 21 D9
J3B 21 D10
J3C 21 D11
J3A 22 D12
J3B 22 D13
J3C 22 D14
J3A 23 D15
J3B 23 XIORD
J3C 23 XIOWT
J3C 30 SMPL
J3A 31
J3B 31
J3C 31
GND
J3A 32
J3B 32
J3C 32
+5V

ANALOG TRANSCEIVER

+5V
J5A 4
J5C 6
J5C 14
J5AC 16
J5AC 18
J5AC 20
J5AC 22
J5C 24
GND
J5A 8 2XFO
J5C 10 TX
J5A 30 BW
J5A 32 TEST
J5C 26 S0
J5C 28 S1
J5C 30 S2
J5C 32 S3

TP2 2XFO
TP1 TX
TP5 +5V
TP4 GND
TP3 SMPL

REV./SIGN.	DATE	DRAW.	CONTR.	AUTH.
NØP		93.06.10	93.06.10	93.06.10
		SEN	OMJ	HS

SIMRAD

SHEET SIZE: | SCALE: | C

824-109327

FILE NO. 643-32

PAGE NO. 1 OF 1

CIRCUIT DIAGRAM
MOTHERBOARD
EY 500
SIMRAD SUBSEA

J2A 2 BW
J2B 2 TAB0
J2C 2 TAB1
J2A 4 RS
J2C 8 TEST
J2C 13 A11
J2A 14 A12
J2B 14 A13
J2C 14 A14
J2A 15 A15
J2A 18 D0
J2B 18 D1
J2C 18 D2
J2A 19 D3
J2B 19 D4
J2C 19 D5
J2A 20 D6
J2B 20 D7
J2C 20 D8
J2A 21 D9
J2B 21 D10
J2C 21 D11
J2A 22 D12
J2B 22 D13
J2C 22 D14
J2A 23 D15
J2B 23 XIORD
J2C 23 XIOWT
J2B 27 TX
J2C 27 2XFO
J2C 30 SMPL
J2BC 7
J2ABC 31
GND
+5V
J2C 26
J2A 29
J2ABC 32

NOTE * VDD TYPICAL 20 VOLTS

J4A 4 + VDD
J4C 4 + VDD
J4A 6 - VDD
J4C 6 - VDD
J4A 8 S
J4C 8 A
J4A 10 B
J4C 10 F
J4A 12 AUX0
J4C 12 AUX1
J4A 16 AGND4
J4C 16 Q4
J4A 20 AGND3
J4C 20 Q3
J4A 24 AGND2
J4C 24 Q2
J4A 28 AGND1
J4C 28 Q1
J4AC 2
J4AC 14
J4AC 18
J4AC 22
J4AC 26
J4AC 30
J4AC 32
GND
+5V

J6A 4 + VDD
J6C 4 + VDD
J6A 6 - VDD
J6C 6 - VDD
J6A 8 S
J6C 8 A
J6A 10 B
J6C 10 F
J6A 12 AUX0
J6C 12 AUX1
J6A 16 AGND4
J6C 16 Q4
J6A 20 AGND3
J6C 20 Q3
J6A 24 AGND2
J6C 24 Q2
J6A 28 AGND1
J6C 28 Q1
J6AC 2
J6AC 14
J6AC 18
J6AC 22
J6AC 26
J6AC 30
GND

+5V
P1 1,7
P1 14,20
+ VDD P1 3
+ VDD P1 16
- VDD P1 6
- VDD P1 19
P1 11
P1 12
P1 25
P1 24
POWER PLUG
P.SHUT-DOWN P1 9,22
P1 2,4
P1 5,8
P1 10,15
P1 17,18
P1 21,23
GND

+5v
P2 1
+ VDD P2 2
- VDD P2 3
SPARE P2 4
P.SHUT-DOWN P2 5
TX P2 6
2XFO P2 8
P2 7
P2 9
P2 10
P2 11
P2 12
P2 13
P2 14
P2 15
AUXILIARY PLUG
GND

./backpl.sbk(01;12) Thu Jun 10 14:50:22 1993

/files1/home/users/mf/project/ey500/pc_interface/1.drw 04 NOV 93 10:27 last update: 14 JUN 93 10:00

PRINTER: P3 11 BUSY, P3 12 PE, P3 13 SLCT, P3 15 ERROR, P3 2 D00, P3 3 D01, P3 4 D02, P3 5 D03, P3 6 D04, P3 7 D05, P3 8 D06, P3 9 D07, P3 1 STR PRT, P3 18–25 GND

PC: P4 2 D00, P4 3 D01, P4 4 D02, P4 5 D03, P4 6 D04, P4 7 D05, P4 8 D06, P4 9 D07, P4 18–25 GND

U5 74HCT374: 1D 2D 3D 4D 5D 6D 7D 8D, CK, OC; 1Q 2Q 3Q 4Q 5Q 6Q 7Q 8Q; 2 SPARE, 12 TX_TRIG

U6 74HCT374: 1D 2D 3D 4D 5D 6D 7D 8D, CK, OC; 1Q 2Q 3Q 4Q 5Q 6Q 7Q 8Q; 2 d0, 5 d1, 6 d2, 9 d3, 12 d4, 15 d5, 16 d6, 19 d7

P5: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

BW, TABO, TEST, SPARE, SMPL~ → P2 A2, P2 B2, P2 C8, P1 A6, P2 C30

U1 8254_ALL: A0 A1 CS RD WR CLK0 G0 CLK1 G1 CLK2 G2 VCC GND; OUT0 OUT1 OUT2; D0 D1 D2 D3 D4 D5 D6 D7

P6: d0 d1 d2 d3 d4 d5 d6 d7

C1 4.7U, C12 0.1U, C3 4.7U, C25 0.68U, R13 47.5K

U16 74HCT74: D PR Q, CK Q, CLR; TX~ → P2 B27, P1 C6

X1115 Y1: 14 5V, 7 0V, 8 OUT

2*f0 → P2 C27; RS~ → P2 A4

TAB1: P2 C2, P2 C13, A11

R6 1.21K, R1 R2 R3 100K, R5

A13 → P2 B14; A14 → P2 C14; A15 → P2 A15; S0 → P1 A13; S1 → P1 C13; S2 → P1 B15; S3 → P1 C15

P7: 1 2 3 4 5 6 7 8 9 10

74HCT04 U3: HF1~ → P1 A8

BUSY,PE,SLCT,ERROR

74HCT253 U15: 1C0 1C1 1C2 1C3 2C0 2C1 2C2 2C3 A B 1G 2G; Y1 Y2

DI8 → P2 C20; DI12 → P2 A22; DI0 → P2 A18; DI4 → P2 B19; DI9 → P2 A21; DI13 → P2 B22; DI1 → P2 B18; DI5 → P2 C19

74HCT253 U10: 1C0 1C1 1C2 1C3 2C0 2C1 2C2 2C3 A B 1G 2G; Y1 Y2

DI10 → P2 B21; DI14 → P2 C22; DI2 → P2 C18; DI6 → P2 A20; DI11 → P2 C21; DI15 → P2 A23; DI3 → P2 A19; DI7 → P2 B20

74HCT157 U9: 1A 1B 2A 2B 3A 3B 4A 4B, A/B, G; 1Y 2Y 3Y 4Y

74HCT157 U14: 1A 1B 2A 2B 3A 3B 4A 4B, A/B, G; 1Y 2Y 3Y 4Y; 2 ERROR, 5 SLCT, 11 PE, 14 BUSY

FIFO START

P4 16 RS~, P4 10 HF1_INT, P4 15 DATA0, P4 13 DATA1, P4 12 DATA2, P4 11 DATA3

FIFO PRT SIGN

R11 R8 R10 332 332 332

74HCT138 U11: A B C, G2A G2B G1; Y0 Y1 Y2 Y3 Y4 Y5 Y6 Y7

P4 17 SEL_A, P4 14 SEL_B, P4 1 STROBE

74HCT393 U7: CLK CLR; QA QB QC QD

TV9 13, TV8 12, TV7 13

74HCT04 U3

TV1 9, TV2 10, TV3 11 — 74HCT27 U4

TV4 3, TV5 4, TV6 5 — 74HCT27 U4

d(0:7)

TP9, TP8

74HCT00 U8

74HCT393 U7

74HCT393 U12

74HCT393 U12

TP5, TP7, TP3, TP4, TP1, TP6, TP2

74HCT27 U4: 1 2 13 → 12; XIORD → P2 B23

74HCT04 U3: A12 → P2 A14

P1 A11, P1 A12, P1 A14, P1 A15, P1 C24, P1 C25, P2 C26, P2 A29, P2 A32, P2 B32, P2 C32

C23 4.7U, C24 4.7U, C15 C21 C14 0.1U, C20 C8 C19 0.1U, C13 C7 C5 0.1U

P1 B2, P1 B6, P1 B9, P1 B13, P1 B17, P1 B20, P1 B23, P1 B26, P1 B29, P1 B32, P2 A31, P2 B31, P2 C31

TP10, TP11

74HCT74 U16: D PR Q, CK Q, CLR; TV10 TV11 TV12 TV13

74HCT123 U13: RC CX A B Q Q CLR; R9 4.75K, C17 82P

74HCT123 U2: RC CX A B Q Q CLR; R7 27.4K, C9 82P

74HCT123: C22 82P, R12 4.75K

74HCT123 U13: R4 4.74K, C6 10P

74HCT00 U8

74HCT04 U3

ALL RESISTORS IN OHM IF NOT OTHERWISE SPECIFIED.
ALL CAPACITORS IN uF IF NOT OTHERWISE SPECIFIED.

COMPONENT TYPES AND VALUES MAY BE SUBJECT TO MINOR CHANGES WITHOUT NOTICE.

9153	MF	
NO.	SIGN	
CORRECT.		

PC-INTERFACE
PCIF

DRAW.	931104	M.F.
CONTR.	931104	JET
AUTH.	931104	H.S.

SIMRAD SUBSEA A/S

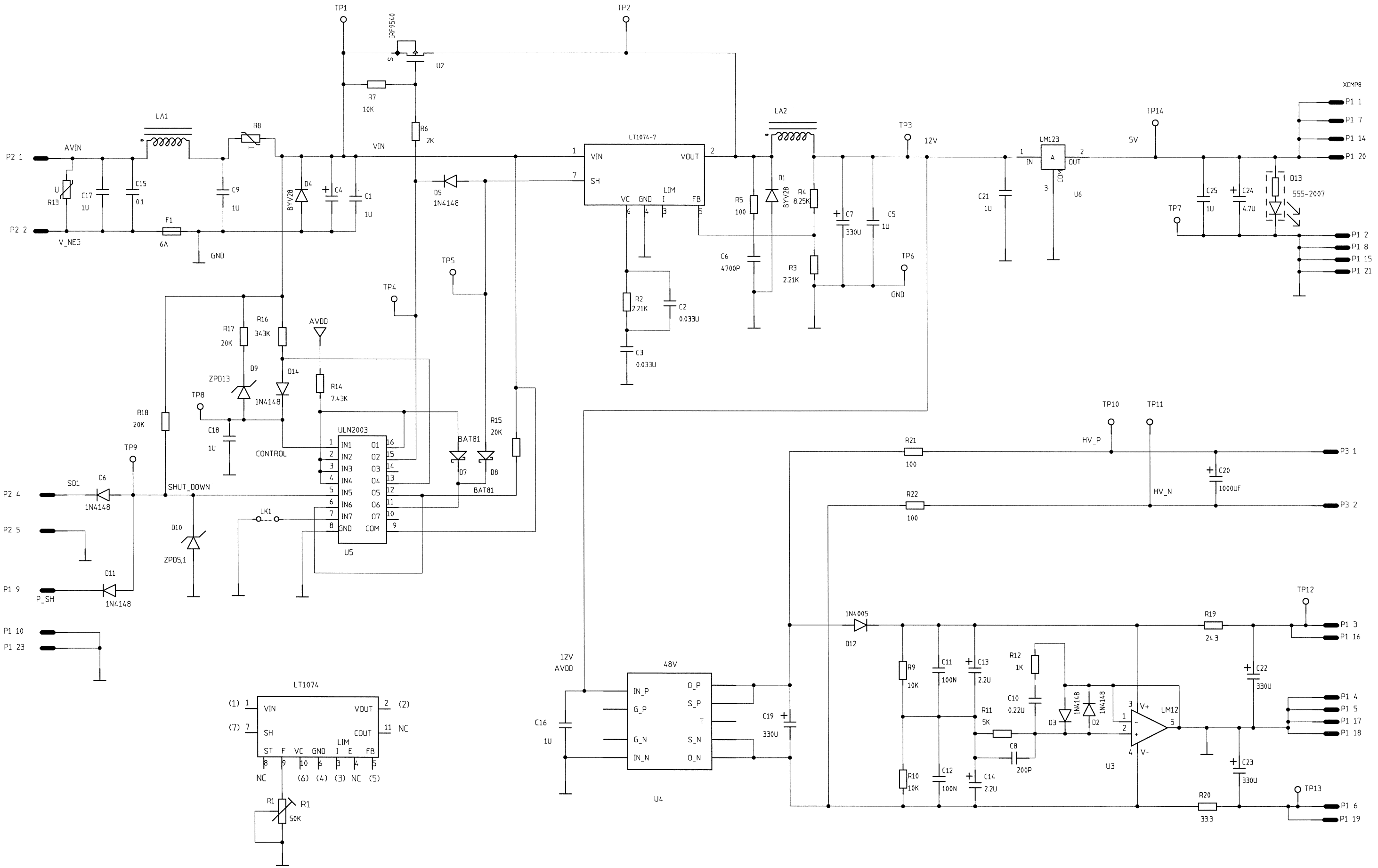
PAGE NO. 1 OF 1

SIMRAD

REPL.

824-109291 C

FILE NO. 620-7



LATER VERSIONS OF THE PCB, U1 IS SUBSTITUTED WITH AN EQUAL LT1074 WITH 7 PINS. NUMBERS IN (..) REFERS TO THE 7 PINS VERSION.

ALL RESISTORS IN OHM IF NOT OTHERWISE SPECIFIED.
ALL CAPACITORS IN uF IF NOT OTHERWISE SPECIFIED.

COMPONENT TYPES AND VALUES MAY BE SUBJECT TO MINOR CHANGES WITHOUT NOTICE.

N1016 96.06.10.	E.F.
NO.	SIGN
CORRECT.	

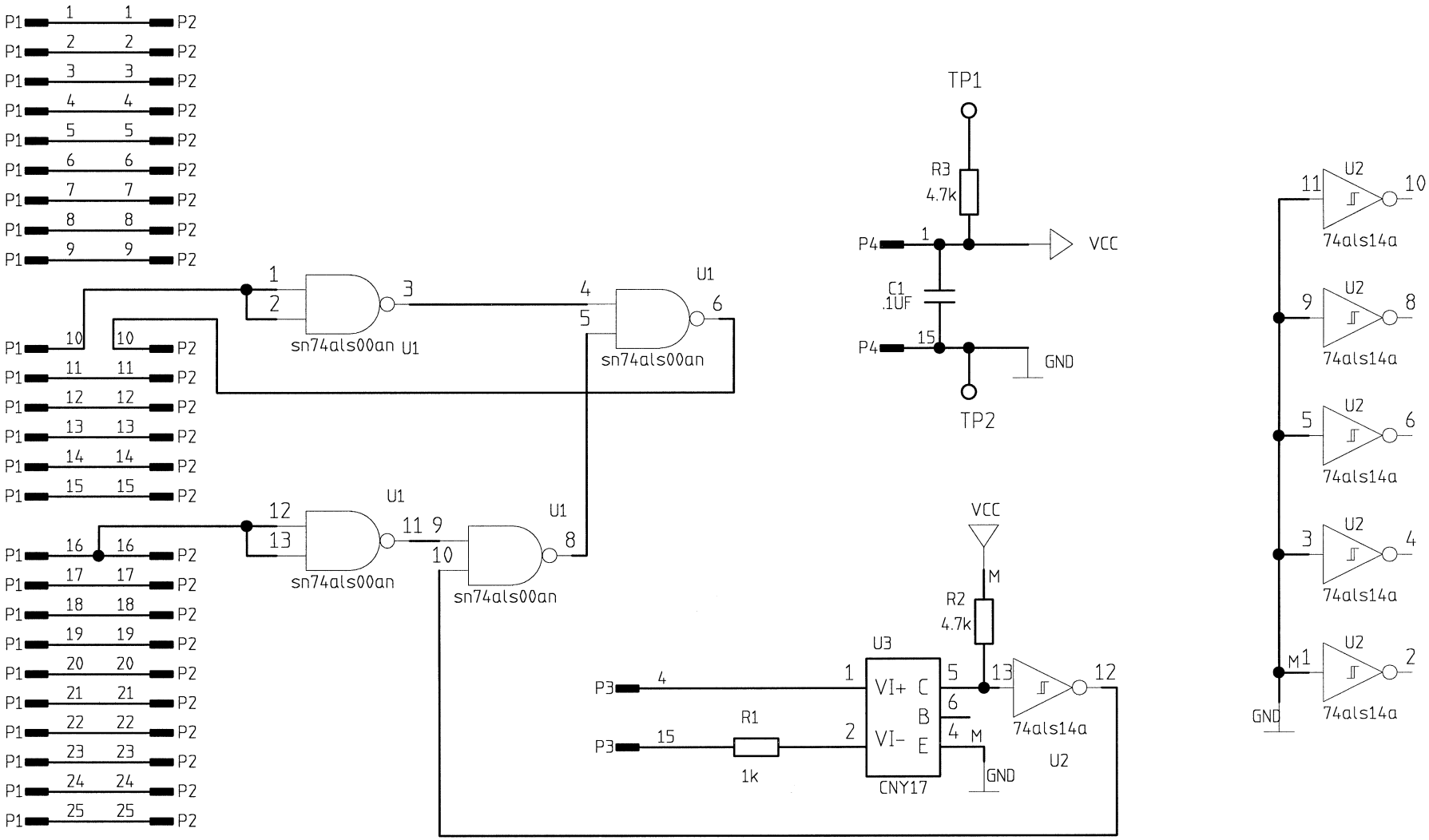
DRAW.	92.12.15	M.F
CONTR.	92.12.15	H.S
AUTH.	92.12.15	R.B

CIRCUIT DIAGRAM
POWER SUPPLY
EY 500 /EA 501P

SIMRAD

REPL.
824-109632 B

PAGE NO. 1 OF 1
FILE NO. 640-74



ALL RESISTORS IN OHM IF NOT OTHERWISE SPECIFIED.
ALL CAPACITORS IN uF IF NOT OTHERWISE SPECIFIED.

COMPONENT TYPES AND VALUES MAY BE SUBJECT TO MINOR CHANGES WITHOUT NOTICE.

REV./SIGN.			
DATE			
DRAW.	95.08.07	S.E.	
CONTR.	95.08.08	H.S.	
AUTH.	95.08.10	E.F.	

CIRCUIT DIAGRAM SYNC. UNIT EY500

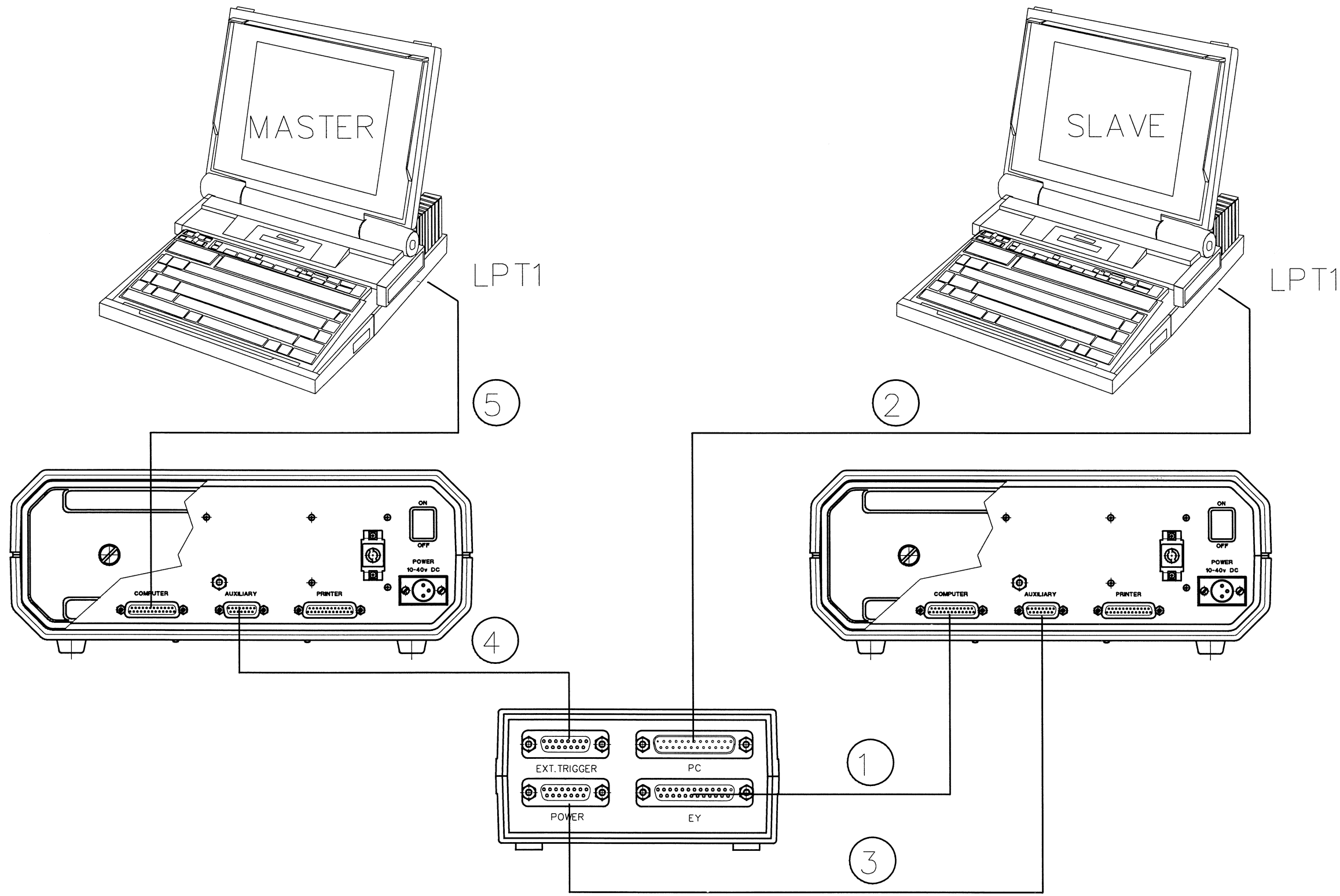
SIMRAD NORGE A/S

SIMRAD

SHEET SIZE:	SCALE:
824-133142	A

PAGE NO. 1 OF 1

FILE NO. 627-15



Cable 1, 2, 5 standard EY/EA to PC cable
Cable 3, 4 15 pin d–con 1 male + 1 female

REV./SIGN.										
DATE										
PROJ. METHOD			UNLESS OTHERWISE STATED, TOLERANCE: DIM.: THREAD:					SIMRAD		
SCALE	1:1		EXT. SYNC., CABLE PLANE					SHEET 1 OF 1	SH.SIZE: A3	REV.:
DRAWN	96.03.21	EF	SYNC. UNIT					824–133141		A
CHECKED	96.03.21	GM								
APPROVED	96.03.21	RB	EY 500 / EA 501P					FILE NO.: 664–64		

SHOW - CONVERT BINARY EY 500 TELEGRAMS TO ASCII

SYNOPSIS

Show input_file [> output_file]
Show -a input_file [> output_file]

Input_file is a EY 500 .dgx file

(Refer to chapter "The Disk Storage" in section "Description of Telegrams and Remote Control" in the EY 500 Instruction Manual.

DESCRIPTION

The Simrad EY 500 echo sounder outputs binary telegrams over the DISK interface and the RS232 interface on PC (default COM2). This program translates binary telegrams into ASCII telegrams providing a useful mechanism for displaying the content of binary data. Using DOS command input is taken from the EY 500 input file name at the command line,and output is sent to the standard output (CRT or a an output file). The telegram formats, binary and ASCII, are described in the EY 500 Instruction Manual, section "Description of Telegrams and Remote Control". Five telegrams are only output in binary format by the EY 500, due to their large size, and no ASCII equivalent is defined in the EY 500 manual. The full content of these telegrams are printed in ASCII using the -a option.The compressed ASCII output formats are described below.

Q1,15280070,Sv, 252.90
pelagic: 0.00, 100.00,250
bottom: 10.00, -5.00,75
B1,15280070
W1,15280070
V1,15280070
P1,15280070

Q1 contains complete echogram data and allows an entire survey to be replayed and recomputed off line on a general purpose computer: header, time tag, data type (volume backscattering strength, target strength), detected depth [meter], upper depth boundary of pelagic echogram [meter],lower depth boundary of pelagic echogram [meter], number of pelagic echogram data points, upper depth boundary of bottom echogram [meter], lower depth boundary of bottom echogram [meter], number of bottom echogram data points.

The pelagic echogram boundaries are referred to the sea surface (positive values below the surface),and the bottom echogram boundaries are referred to the detected bottom (positive values above the bottom).

B1 contains raw angle sample data from the transceiver (applies to split-beam transducer channels only): header, time tag, angle data points [phase steps] alongship angle followed by athwartships angle).

W1 provides raw power sample data referred to the transducer terminals as measured by the transceiver: header, time tag, amplitude data points [dBW].

V1 provides volume backscattering strength sample data: header, time tag ,amplitude data points [dB].

P1 provides target strength sample data: header, time tag, amplitude data points [dB].